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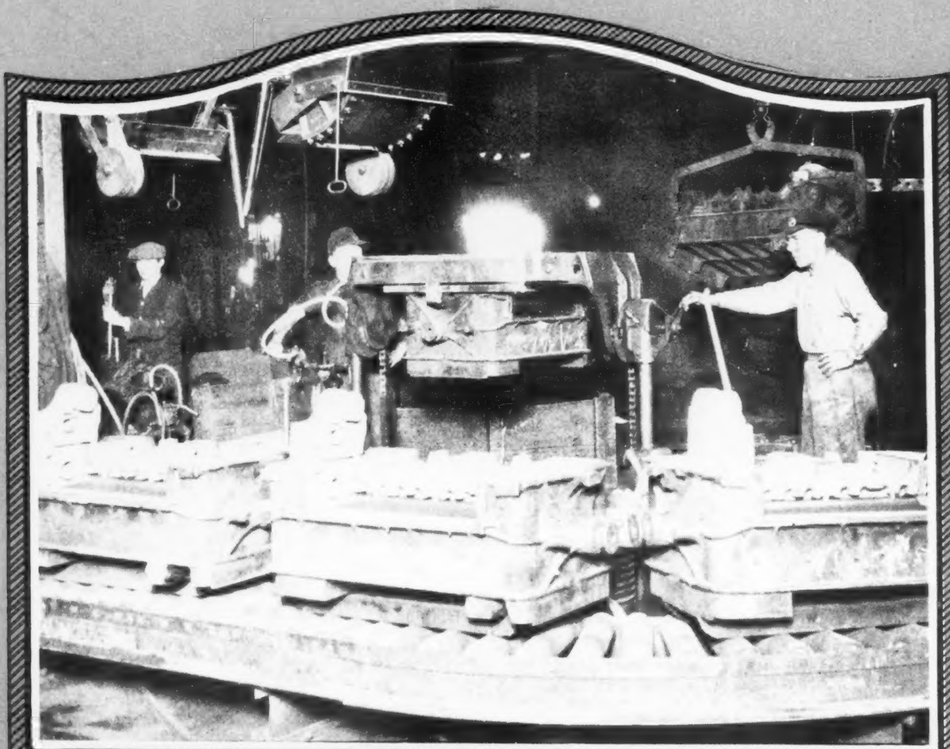

IN FOUNDRIES WHERE QUANTITY PRODUCTION IS THE AIM AIR-OPERATED MOLDING MACHINES ARE INDISPENSABLE

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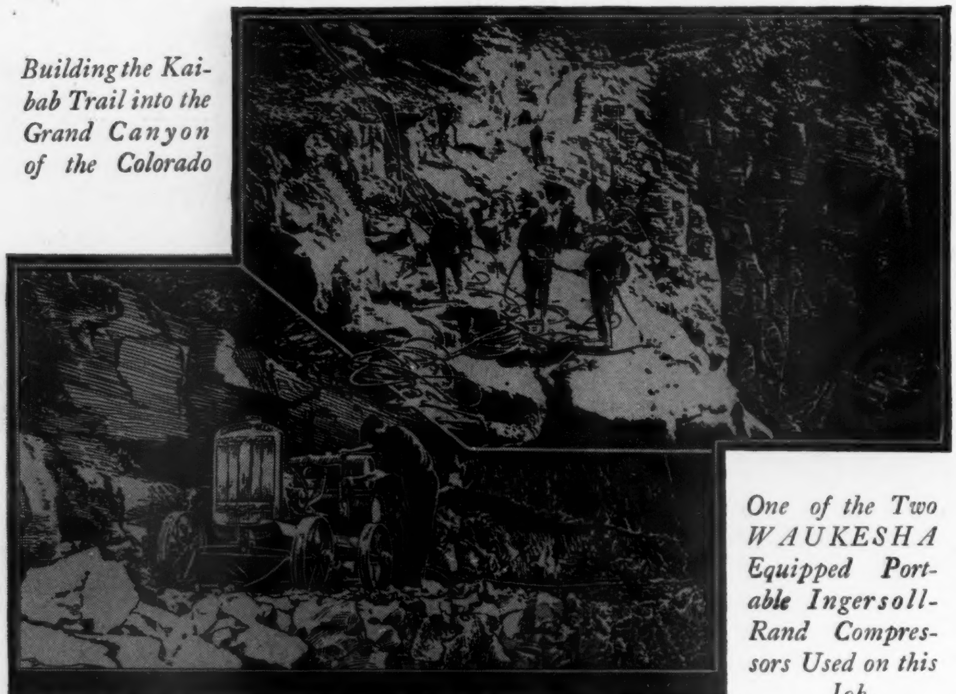
Building the Kaibab Trail into the Grand Canyon of the Colorado



One of the Two WAUKESHA Equipped Portable Ingersoll-Rand Compressors Used on this Job

n-731-LC

Changing Nature's Face

Nature's brilliantly colored face as it is presented in the Grand Canyon of the Colorado now bears another line—the "Kaibab" trail. 3,350 feet in a distance of 4.6 miles this new and safe trail drops down to the Colorado River. Its unusually rapid construction during one Winter season was due largely to the use of reliable and simple gasoline engined portable air compressors.

Two crews, one at the top, the other at the bottom, each with a Waukesha engined 4¼"x4" portable Ingersoll-Rand Compressor did the job. The lower power unit was taken down piecemeal on burros and assembled at the foot of the trail. That the men who assembled and handled it had no trouble is a wonderful demonstration not only of the "fool-proofness" of Waukesha "Ricardo Head" Engines and Ingersoll-Rand Compressors, but of the integrity of present day class of laboring men.

N-753-LC

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Exclusive Builders of Heavy Duty Gasoline Engines for Over Twenty Years

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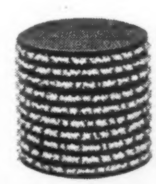

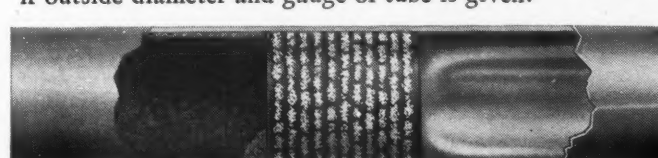

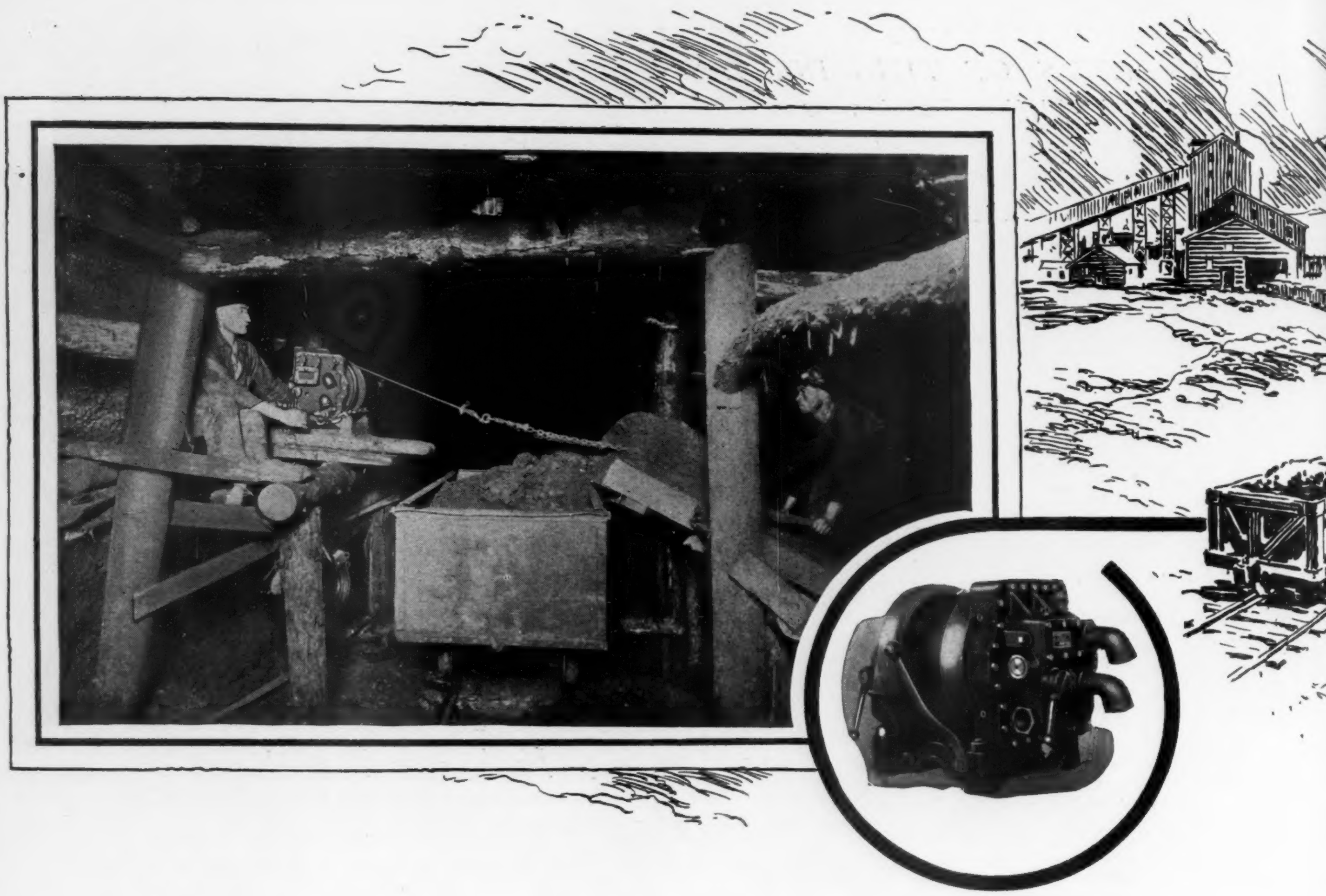

Making and Breaking

"Little Tugger" Hoist

This compressed-air-operated machine saves 50% of the cost of hand mucking.

It can be mounted anywhere, in a few minutes' time, without special equipment. Though powerful, economical, and safe, it is simple in construction, and its operation can be trusted to any person on the job.

"Little Tugger" slushing has been successfully applied to practically every method of modern mining without any change in the original mine layout. In planning the layout for a new level, however, arrangements should be made to take the greatest advantage of "Little Tugger" slushing.

"Little Tugger" Hoists are made in single- and double-drum models and with one-way and reversible engines. They are furnished for operation on either air or steam.

Monetary success in industry depends, in the main, upon quantity production at low cost. In mining, for instance, the yardstick is the "cost per ton to produce." Therefore, the aim of the wide-awake manager is to increase tonnage output without increasing labor charges.

In response to the world-wide demand for an increase in man-day tons, the Ingersoll-Rand engineers have developed a very effective combination of equipment that has proved highly successful wherever employed.

This combination is made up of the I-R "Little Tugger" Hoist and the RB-12 Auger Drill. These machines, when used in mining iron ore, have been strikingly effective in getting out a larger tonnage at a marked reduction in cost.

The Lake Superior district accounted for 85% of the

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Western Foundry Finds Way To Effect Substantial Savings

Most Modern Methods Are Utilized By a Muskegon Plant In Producing 400 Tons of Motor Castings Daily

By C. H. VIVIAN

THE Campbell, Wyant & Cannon Foundry Company of Muskegon, Mich., has risen to a position of eminence among producers of automobile-engine castings by rigidly adhering to a policy of specialization. Founded less than two decades ago, the business has expanded at such a brisk pace that it is, today, the largest jobbing foundry making this class of products.

The reader who possesses some knowledge of the foundry industry will recall that only a few years ago the pouring of 50 tons of metal castings in a day was deemed a remarkable performance. For the sake of comparison, and to emphasize the increasing importance of the foundry in the industrial world, it is worth mentioning that the Campbell, Wyant & Cannon plants operate on a schedule that calls for a daily production throughout the year of from 350 to 400 tons of castings.

When it is considered that the output consists of castings ranging in weight from less than a pound up to more than 400 pounds, some idea may be had of the thousands of individual castings that are made within the course of every 24 hours. Expressed in terms of only automobile cylinder blocks, a 400-ton production would represent more than 4,000 blocks for 6-cylinder cars of medium size.

The history of the company dates from 1908, when Messrs. D. J. Campbell, I. A. Wyant, and G. W. Cannon associated themselves and entered business in Muskegon in an old foundry building, which they leased. At the outset, the three partners represented the entire labor force; but before the first year had ended they had 25 men in their employ. Since then the firm has recorded a steady annual growth, an increasing volume of business, that has made it necessary from time to time to move the plant into larger quarters.

MANY successful and sizable manufacturing concerns owe their growth, in no small measure, to the fact that they have heeded the sage counsel of the old adage concerning the shoemaker and his last.

By limiting their activities to the making of a few closely related products, they have been able to give to their factory problems and processes that constant study which paves the way for continual improvement in methods. With such firms, vigilance and progress are synonymous.

The Campbell, Wyant & Cannon Foundry Company has attained an enviable position in its field by being ever on the alert for ways and means to increase efficiency and to reduce costs.

Compressed air is an indispensable source of power in the foundry, and any economy realized in producing that air is worth while. The experience of the Campbell, Wyant & Cannon Foundry Company has confirmed this fact. The oil-engine compressors installed by them have materially added to the general efficiency of their foundry.

All three of the directing heads of the concern were thoroughly schooled in foundry practice. Each served as apprentice, then journeyman, and, finally, as superintendent. Their combined experiences covered various kinds of foundry work in several sections of the country. The impelling motive behind their association was the belief each held that he could better prevailing methods of foundry production through improved organization, more thorough training of workmen, and the introduction of labor-saving devices. It is well to keep these points in mind, for they are intimately related to this story.

The foundry's first product was marine-engine castings—the output at the end of the initial year being 12 tons daily. Doing a large portion of the work themselves, and personally supervising the remainder of it, the three firm members were able to carry out in detail their ideas for the improvement and the development of methods and equipment. They obtained results which began to attract attention; and soon they received an order from the Continental Motors Corporation for automobile-cylinder castings. Since then they have been identified almost exclusively with the automotive field; and they have always limited their work to a few closely related castings.

During the World War, the output consisted largely of cylinder blocks for Liberty motors for trucks and aircraft, and of submarine-engine castings. This work was done under government supervision—the specifications calling for extreme accuracy and first-class quality. The products were given such high ratings by federal inspectors that the Canadian Government enlisted the services of the company to

Because of their dexterity, girls become expert in the making of the smaller cores, and many of them are employed in the Campbell, Wyant & Cannon Foundry Company for this work.

make some special castings. Towards the end of the war, special equipment was installed and production started on die castings for use in manufacturing French "75" field guns for the American forces overseas.

At the present time, the Campbell, Wyant & Cannon Foundry Company makes cylinder blocks, cylinder heads, pistons, flywheels, and similar component parts of automobile power plants or engines, for several of the leading motor-car builders of the country. The prices of the automobiles into which these products enter range all the way from $900 to $20,000 for a single model. The daily schedule of cylinder-block production varies from 10, of some types, up to 800 of other types. The labor force totals about 1,600.

The growth of the company has naturally brought about many changes in its physical properties. In 1910 it left its first quarters for larger ones, acquiring a plant that had formerly been used as an iron foundry. This became No. 1 and No. 2 plants, aggregating 280,000 square feet of floor space. By 1920, more room was required; but as there was none to be had adjoining the existing location, the company purchased 360 acres of land a mile distant from its old plants and outside the city limits of Muskegon. There it laid out and built a new plant, designated as No. 3. Ample ground is available there for future growth; and some choice acreage has been set aside for the development of a homesite for company employees. The first unit of the new foundry was built in 1921, and an addition was constructed in 1926. The floor space now totals 178,000 square feet.

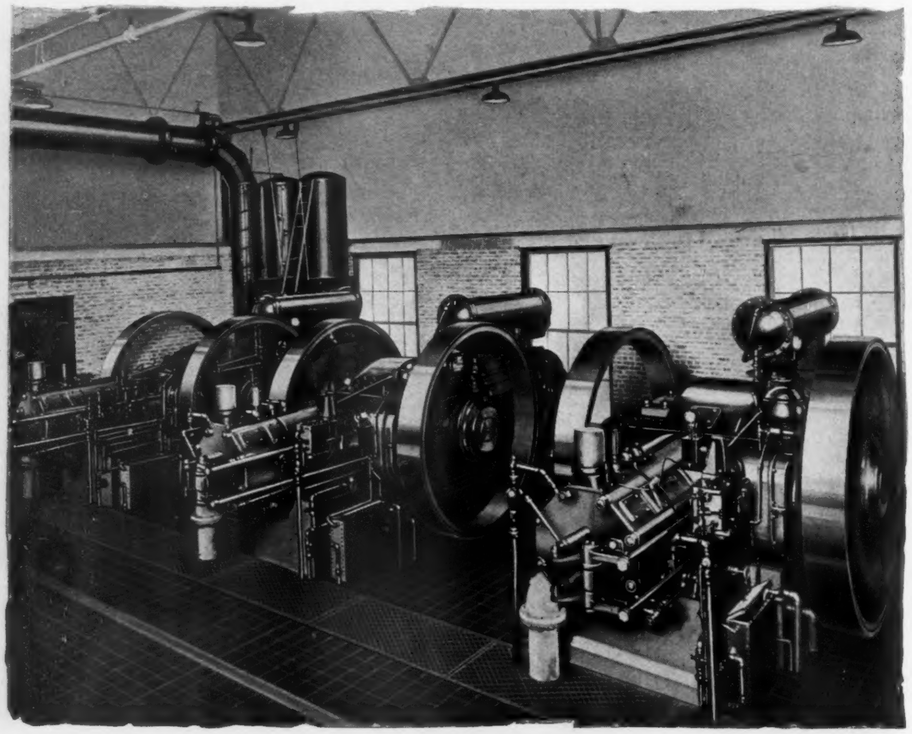
The daily production of No. 3 Plant varies during a year from 240 to 280 tons of castings, though it has reached 315 tons in a single day. The output of No. 1 Plant ranges from 110 to 120 tons of castings a day. The No. 2 Plant is now idle, except for a section that serves for the making of cores for No. 1, and another part that is occupied by the company's general offices. The new foundry is of the most modern construction and occupies an attractive natural setting which has been further enhanced by lawns, shrubbery, and trees. The plant has its own water-supply system—a flow of 600 gallons per minute being pumped from a well to a distributing tank.

In view of what has been said of the personnel of the firm and of the factors responsible for the company's success, it is perhaps superfluous to state that the new plant exemplifies the most modern ideas in foundry arrangement and in methods that will tend to produce a superior product with a minimum expenditure of hand labor and in the least possible time. Many operations which were performed by hand a few years ago, and on which small foundries still use varying degrees of manual labor, are done in this plant entirely by machine. Compressed air is the force that actuates many of these machines—in fact, it may be said to be an indispensable motive medium without which progress would stop. There are literally hundreds of units driven by compressed air. The services it renders are, in general, akin to those performed by compressed air in the typical foundry, but with this distinction: man-held tools are present in lesser number and extent, while ingeniously contrived machines assume greater importance.

To gain a clearer conception of the true significance of compressed air in a foundry of this size it would, perhaps, be well at this point to give a few figures on air consumption and some facts regarding the source of the air. The total compressor capacity in the operating plants is 10,185 cubic feet per minute. Some of this is reserve power, which is required only under peak conditions. However, when 400 tons of castings are being poured daily, the air requirement is approximately 7,200 cubic feet per minute over a period of 12 hours out of the 24, while the minimum demand during the remaining 12 hours is 3,300 cubic feet. The air is used throughout the plants at a pressure of from 95 to 100 pounds. At No. 1 Plant, 900 cubic feet of air is supplied by an "Imperial" Type 10 compressor, which has been in continuous service for more than 12 years. It is belt driven from a motor. Besides, 1,600 cubic feet of air is furnished by a PRE-2 compressor, direct driven by a synchronous motor. This machine also has been in service for a number of years.

Corner of one of the washrooms. Hot water for washing purposes is drawn from the water jackets of the oil-engine-compressor units.

1—Speed of production in this up-to-date foundry is materially helped by the air-operated molding machine here seen at work.
2—Cleaning cylinder-block castings with I-R pneumatic grinders.
3—Castings are handled at this air-driven core-knockout machine by means of an I-R air hoist.
4—A modern foundry finds the air-driven chipper indispensable in removing excess metal from castings.
5—Power-driven tumbler used in cleaning certain types and sizes of castings.



The three POC-2 oil-engine air compressors that have made it possible to effect substantial operating economies. Each of the units has a piston displacement of 895 cubic feet.

When the new foundry was completed, it was equipped with two motor-driven compressors having respective capacities of 1,800 and 2,800 cubic feet of air per minute. However, in 1926, the economies to be derived from the use of oil-engine compressors came to the attention of the management; and, after investigating the merits of the machines, there were purchased three POC-2 units. These were installed in March; and in October they assumed the principal burden of furnishing the air supply that is so vital to the effective operation of the foundry.

Each unit consists of an Ingersoll-Rand Type PO, 150-hp. oil engine, direct connected to a 2-stage compressor. The oil engines are of the 4-stroke-cycle, solid-injection type, designed for simple, reliable action and ease of functioning. Each has a piston displacement of 895 cubic feet per minute.

The economies shown by the POC-2 compressors are especially pronounced when they are operated well-nigh continuously under full load; and these are the conditions that obtain in this instance. From 5:30 in the morning until 5:30 or 6 o'clock at night, the air requirements of the No. 3 Plant are about 4,300 cubic feet per minute. Prior to the installation of the oil-engine units, this demand necessitated running both motor-driven compressors throughout the day. Now the three POC-2 machines, together with the 1,600-cubic-foot electric-powered compressor, are operated continuously during that period. The 2,800-cubic-foot motor-driven unit is not used. When the air consumption falls below the amount being compressed, the load is eased on the motorized unit—the oil-engine compressors maintaining full-load operations all the time. From 5:30 or 6 p. m. until 8 p. m., the entire air requirements are taken care of by the three oil-engine compressors working at full load. But from 8 p. m. on until 5:30 in the morning, two of the POC-2 units suffice to supply the needed air—one of the machines is thus out of service for about 10 hours in every 24 hours.

Speaking recently of the work of these compressors, Mr. C. T. Hildebrandt, the plant engineer of the Campbell, Wyant & Cannon Foundry Company, said: "We are well pleased with the operation of the POC-2 units; and we find them most economical and reliable in our service."

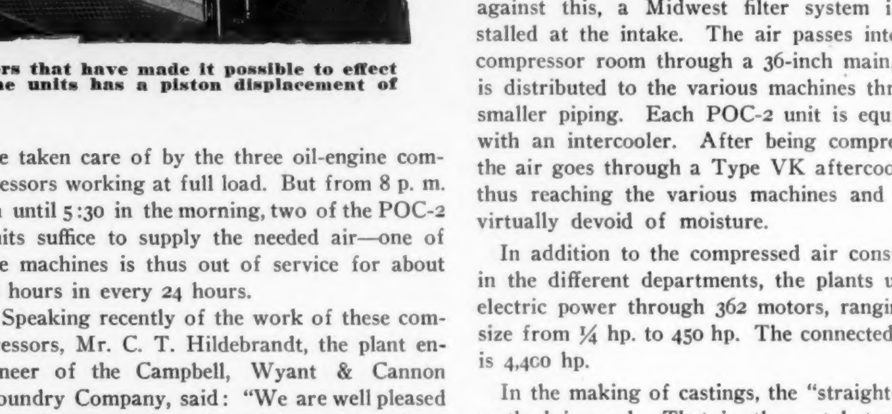
Mr. Hildebrandt has plans formulated and partially carried out that will enable him to effect further savings as a result of the use of the new compressor units. The water that has been employed for cooling the engine cylinders is piped about the plant to serve the various washrooms. The supply is ample for this purpose. The water leaves the jackets at about 105° F., and is hot enough at the taps to call for the admixture of some cold water before it can be used.

Additional plans for salvaging waste heat have to do with the utilization of the radiation from the engine-exhaust pipes. Cold air will be forced in from outside the building through a duct and will pass through a housing to be built around the three exhaust pipes. It will then go into the pattern-making shop adjacent to the engine room. During cold-weather months, this continuous flow of fresh air will assure the workers in that department a comfortable working temperature. Thus the heating plant will be relieved somewhat, with a consequent saving in fuel.

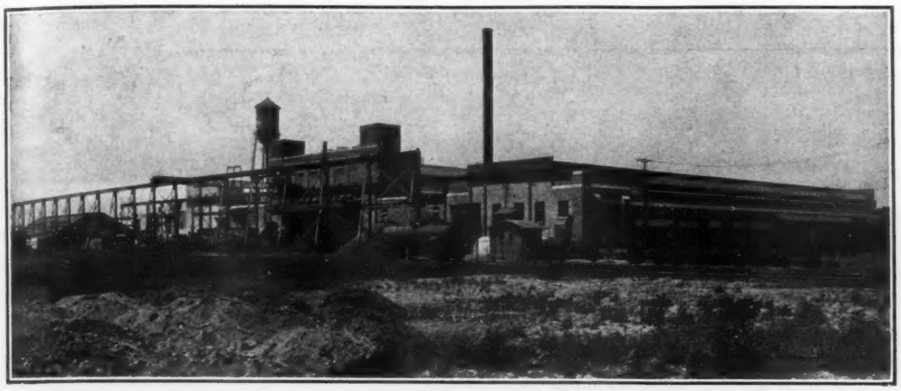
In conformity with its policy of careful and efficient operation, the management has provided suitable apparatus to cleanse the air fed into the compressors. The air intake is just outside the building, adjacent to an area where coal is unloaded. Dust from this source and from the foundry would prove wearing to valves and other compressor parts if it were allowed to enter the machines. To guard against this, a Midwest filter system is installed at the intake. The air passes into the compressor room through a 36-inch main, and is distributed to the various machines through smaller piping. Each POC-2 unit is equipped with an intercooler. After being compressed, the air goes through a Type VK aftercooler—thus reaching the various machines and tools virtually devoid of moisture.

In addition to the compressed air consumed in the different departments, the plants utilize electric power through 362 motors, ranging in size from ¼ hp. to 450 hp. The connected load is 4,400 hp.

In the making of castings, the "straight-line" method is used. That is, the metal, together with coke and fluxing materials, enters the plant at one side and passes successively through the requisite operations until it emerges in the form of finished castings on the loading platforms at the opposite side. The workmen are called upon to move about but little, in fact, most of them perform their particular tasks within a few square feet of space—the materials being fed to them mechanically. The procedure can best be explained by



Fine-appearing Plant No. 3, showing the loading platform at front of structure.



Rear view of Plant No. 3 with the facilities for handling incoming raw materials.

briefly detailing the history of a cylinder-block casting.

The workmen who prepare the molds are stationed in line beside a traveling conveyor on which the products made by them are carried along at a rate of speed synchronized with the speed of the assemblers or operatives. The lower portion, or drag, of the composite mold is made first. The flask is placed on a molding machine, to which is affixed the metal pattern. For his sand, the workman has but to pull down an overhead chute; shift a lever which opens a gate in a hopper above; and allow the desired amount to flow by gravity into the mold. He next closes the gate and pushes the chute up out of his way. Through a jolting motion, imparted to the molding machine by a compressed-air cylinder, the flask is vigorously vibrated—an up-and-down movement serving to pack the sand firmly within it and around the pattern. As the sand is thus compacted, enough more is added to fill the flask heaping full, after which the sand is leveled off even with the top of the flask. Compressed air then exerts pressure on the sand, which is squeezed between the pattern below and a plate above, consolidating it sufficiently so that it will retain the impression of the pattern. The flask with its contained mold is then taken up from the machine by air lift, turned over, and deposited on the conveyor. Loose grains of sand are blown from its surface by a small air gun.

At this stage of the operations, the cores, which have been previously prepared in the coreroom, are set in the drag—gages being used to locate them properly. In the meantime, the cope, or upper part of the mold, has been assembled on another molding machine farther along the line and is ready to be put on top of the drag when the latter arrives. The next step is the placing of the runner box on top of the cope. It is by way of the runner box that the molten metal is poured into the mold through a number of small openings which cause the metal to spread out uniformly and prevent a sudden rush of such force as would break down the green sand.

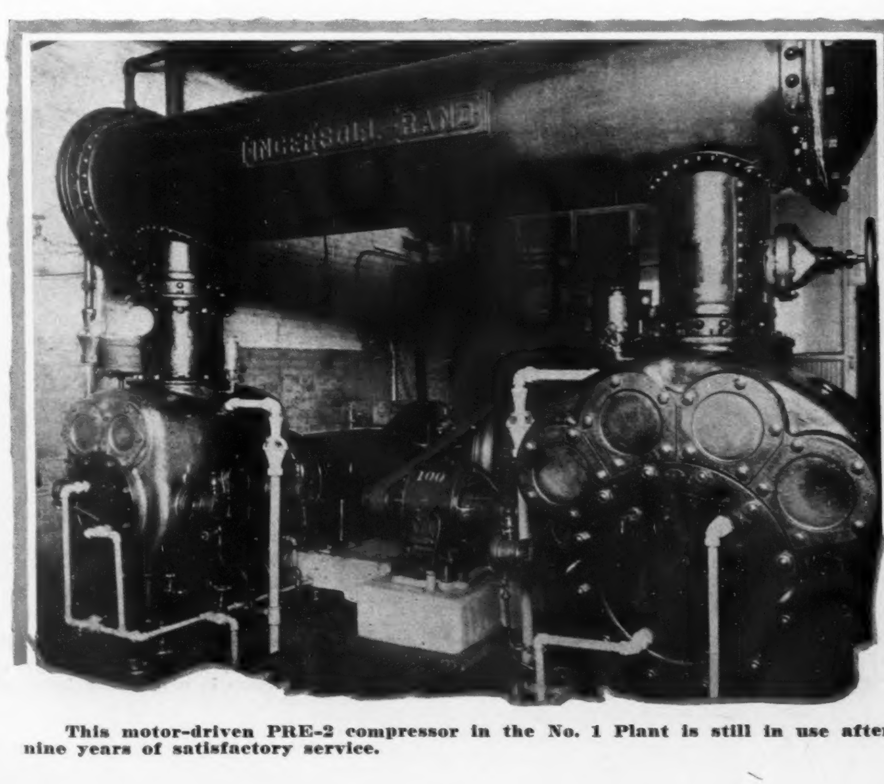
The number of molding machines along the assembly line is such that the conveyor, when it has passed them all, contains a finished mold every few feet. Before we leave the molding machines, it may be stated that they are of various types and sizes suitable for the handling of the different molds employed. Their lifting capacity ranges up to 2,800 pounds, and some will handle flasks up to 36x54x14 inches. On flasks of this size, the molding machines, which are fitted with air cylinders ranging up to 30 inches in diameter, exert a squeezing pressure of 35 pounds to the square inch.

As the assembled and locked molds near the upper end of the conveyor line, the metal is poured into them. Five cupolas are installed for preparing the metal—two being used at a time. The metal is poured from ladles, of 1,200 pounds capacity, which are carried on chain blocks suspended from overhead rails. Before pouring is started, three small test bars of metal are taken from each ladle, and these bars are immediately dispatched to the company's research laboratories for analysis. Before a casting has gone through the plant, the composition and other essential information concerning the metal are known. It is thus insured that all castings shall meet the specifications governing them.

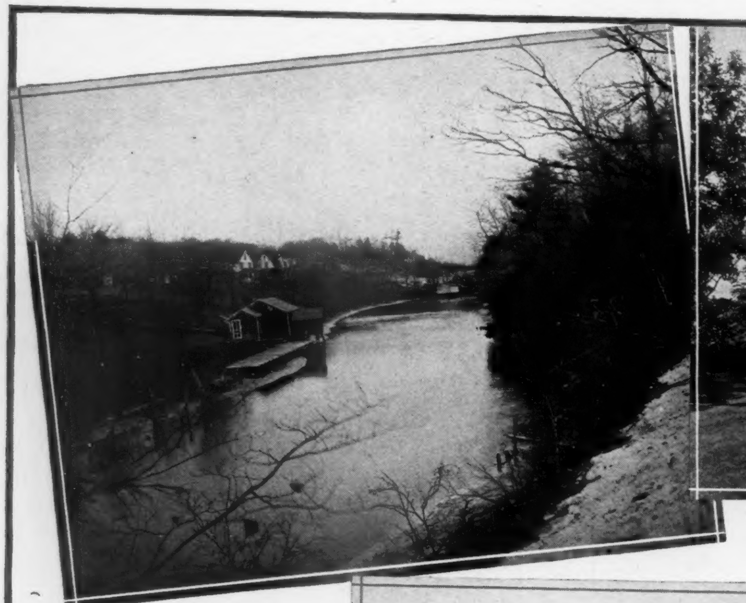
The casting, still on the conveyor, next passes through a cooling tunnel. This is a sheet-metal housing connected with chimneys on the roof of the plant that induce a natural draft. The casting, encased in its mold, emerges from the tunnel into what is known as the "shake-out" zone. There the cope is lifted off by air hoist; vigorously shaken by air vibrators to remove the sand; and set aside for return to one of the molding machines. The casting is taken out of the drag by air hoist; stored on skids; and, when a load has accumulated, is carried by electric truck to the adjacent cleaning room. The drag from which the casting was extracted is lifted by an air vibrator that shakes out the sand. The drag is then ready to go back to the original point of use.

Figures convey in more striking fashion than words a conception of the degree to which organization and mechanization have speeded up the production of castings. Under normal conditions, only 24 minutes elapse from the time the making of the drag is started until the finished casting is removed from the mold. Under stress of peak operations, the working time has been reduced to 18 minutes. The foundry of just a few years ago would have required several hours to accomplish the same work.

The sand that is taken from the flasks in the "shake-out" zone falls through gratings in the floor on to a wide conveyor belt. This belt passes over a magnetic pulley, where all iron is extracted. The sand is then conveyed by elevator to a riddle, which breaks up all lumps. It next goes to a conditioning machine, which has a capacity of 90 tons an hour. From there it is delivered to storage bins, ready for re-use. Conveyors move supplies of sand to the hoppers, which are on overhead rails and within easy reach of the molding machines. The sand bins have a capacity of 160 tons.



This motor-driven PRE-2 compressor in the No. 1 Plant is still in use after nine years of satisfactory service.



A group of attractive scenes in and around Muskegon, Mich. The city is built upon the banks of Lake Muskegon, which is connected to Lake Michigan by a man-made channel. Muskegon is a bustling industrial community.

The core sand, which is a lake product obtained from pits on the company's property, is used but once. The coremaking departments are served by molding machines similar to but smaller than those already mentioned. No squeezing is resorted to in producing the cores, as the required degree of compactness is imparted by jolting. Every core bears the maker's number and the date of molding to facilitate tracing the source of a poor casting due to a defective core.

After it is taken from the molding machine, the core is cleaned with a jet of compressed air and is pneumatically coated with blacking that serves to prevent fusing of the sand when it comes in contact with the molten metal. As it is essential to the formation of a perfect casting that gas be allowed to escape from the molten mass, a strip of paper is pasted over a suitable area on the core before the blacking is applied. The paper is later removed, leaving unprotected sand which yields sufficiently under the action of the hot metal to form gas vents. After the core has received its protective coat of blacking, it is placed, with others, on a slowly moving rack which is drawn through ovens heated by oil burners. Here the cores are baked to give them firmness.

As the specifications under which the castings are normally made allow a tolerance of but 1/64 inch, and in one case of only 5/1000 inch, the exactness of the operations can be appreciated. To meet these requirements, cores are made a trifle oversize in some dimensions and machined to exact size after being baked. The coremaking department is obviously an important one and employs several hundred skilled workmen. Some of the most expert craftsmen on the small cores are women. A piecework wage scale governs the pay of the coremakers.

In our discussion, we left the rough casting—sand covered and still bearing its cores—in the cleaning room. It is there picked up by an air hoist and put in a core-knockout machine. Air pistons clamp the casting into position and hold it securely while vigorous vibrations imparted by air power, jar the cores loose and shake them out. This is accomplished in the space of a few seconds, whereas it used to call for hours of effort by hand-labor foundry methods.

After the cores are removed, an air hoist places the casting on a gravity conveyor which carries it to the tumblers. These are revolving metal drums, capable of holding from 12 to 50 cylinder blocks. In these, the castings are turned over and over for more than an hour while star-shaped bits of steel scour their surfaces to get rid of any fused sand which adhered to them during the casting process.

After being thus cleaned, the casting passes by gravity conveyor on to a workman who grinds off sprues, gates, fins, or other projecting masses of metal or fused metal and sand. For this work, electrically operated grinders, mounted on swinging arms, are utilized on large and exposed areas, while hand-held grinders, driven by compressed air, are used on the smaller and less accessible portions. With the grinding finished, the casting is further smoothed off and evened up by air-operated chipping hammers.

At this stage the casting receives its first inspection. The wires employed to reinforce the cores were not removed by the knockout machine and still remain in the various openings. They are withdrawn by a workman with pliers. When his strength is insufficient to do this, he resorts to the ever-dependable air lift. The cylinder block is now ready for final inspection. It is not only examined minutely by experts, who check all finished surfaces, but it is also given a leakage test. This is effected by a machine which clamps rubber stops over all openings. Water under 100 pounds pressure is then applied through the centers of these stops; and in this way any leakage at once becomes apparent to the inspectors.

By this time the casting has progressed the width of the building. The water-testing machines are adjacent to the wall opposite that where the cupolas are stationed. Following the inspection, the block is conveyed by gravity to a loading platform outside. Space is available there for the loading of 18 cars at a time. The complete operation, from the melting of the metal to the consignment of the finished casting to a car, normally requires but 24 hours, but it can be accomplished in a small fraction of that time. In practice, castings from the foundry floor accumulate faster than they can be cleaned, and the cleaning department is ordinarily working on material that was cast several hours previously.

The transportation facilities at hand are such that the casting we have been describing may be loaded on the afternoon of the day on which it was made and reach its destination at a Detroit automobile factory on the following morning. There it may be handled with such dispatch as to be machined and in position in a chassis the same afternoon. Some cylinder blocks are now partially machined at the foundry and are marked for proper placing in the jigs, which will complete the work at the factory.

Two operations which sometimes contribute to the history of a casting have so far not been referred to in this story. The first of these is welding. Certain imperfections in castings do not affect vital parts and can be adequately remedied in the welding department. There the casting is conveyed through oil-fired furnaces and raised to a cherry-red heat, in which condition it can be welded without setting up rupturing strains.

The second operation is sand blasting. Some customers specify that their castings shall be sand blasted—that is, cleaned by a blast of sand impelled with compressed air. This is done in a closed room by a workman suitably clothed so as to be protected against dust and flying sand. The sand and dust from the sand-blasting room, as well as that from the cleaning tumblers previously mentioned, is drawn by exhaust fans into dust collectors, from which it is removed once a day.

The Campbell, Wyant & Cannon Foundry Company has not lost sight of the human element involved in its organization. Wash and locker rooms are provided, and there are facilities for serving noontime meals; a directed welfare program is carried out; and workmen are given an opportunity to acquire desirable homes in the district which has been set aside for that purpose. American labor predominates. The payroll aggregates more than $3,000,000 annually.

Officers of this outstanding company are: D. J. Campbell, president; G. W. Cannon, vice-president; and I. A. Wyant, secretary and treasurer. These officials, together with A. W. Torpet, form the board of directors. The company has contributed much to the upbuilding of Muskegon, which is an attractive city of approximately 60,000 people, situated on the eastern shore of Lake Michigan in a region whose many natural advantages have made it popular among sportsmen and summer tourists.

RAILWAY WORK IN CANADA

THE Canadian National Railways are engaged in an extensive program of new construction and improvements throughout the entire system from the Atlantic to the Pacific. *Commerce Reports* tells us that the maintenance department is relaying 297 miles of main-line track with 100-pound rails and 421 miles of other track with 85-pound rails—the track material required including 4,042,000 tie plates and 858,000 rail anchors. Ballasting operations now under way will call for 317,000 cubic yards of crushed rock, 24,000 cubic yards of slag, and 1,763,000 cubic yards of gravel. Most of this is to be utilized on the line between Montreal and Toronto.

The program also provides for the extension of the automatic-signal system from 38 miles to 55 miles; for the replacement of numerous wooden trestles with trestles of steel and concrete; and for the erection of many new structures, such as passenger stations, quarters for the reception and inspection of immigrants, engine-terminal buildings, coaling plants, etc.

BIG IRRIGATION PROJECT IN GREECE

THE work of draining and irrigating the Saloniki Plain of Greece, which was begun about the middle of 1926, is progressing rapidly. The contract for this big project involves an expenditure of approximately $25,000,000 and was awarded to an American concern, which has largely supplanted the hand labor commonly used in that country by up-to-date machinery and equipment.

The undertaking includes the drainage of lakes Ardzan and Amatovo by means of a canal, 39.5 feet wide and 7.5 miles long, which will discharge into the Vardar River. This work is at present being pushed by the aid of tractors, drawing scrapers, and by excavators of the type employed in digging the Panama Canal.

It is estimated that it will take about four years to complete the project, which will make available for agriculture about 326,000 acres of rich soil that is now useless marshland.

Traffic in Los Angeles Little Hampered While Driving Long Tunnel

By M. WHARTON

TRAFFIC is a continuous procession of values. Any congestion and delay, involving as it does a loss in time, is a serious economic waste that grows in proportion to the tide of moving vehicles. Not long ago, the City of Los Angeles was faced with the problem of building a sewer, more than a mile long, beneath some of its busiest thoroughfares. How was the conduit to be constructed without keeping the streets torn up for months running and tying up traffic? The problem was solved by driving a tunnel which, being comparatively small in diameter, was advanced by means of air jacks. This was something of a departure from the practice usually followed west of the Rockies in work of this kind; but it has proved entirely satisfactory.

© Dwyer Studio.
One of the five shafts along the line of the new 5,575-foot sewer.

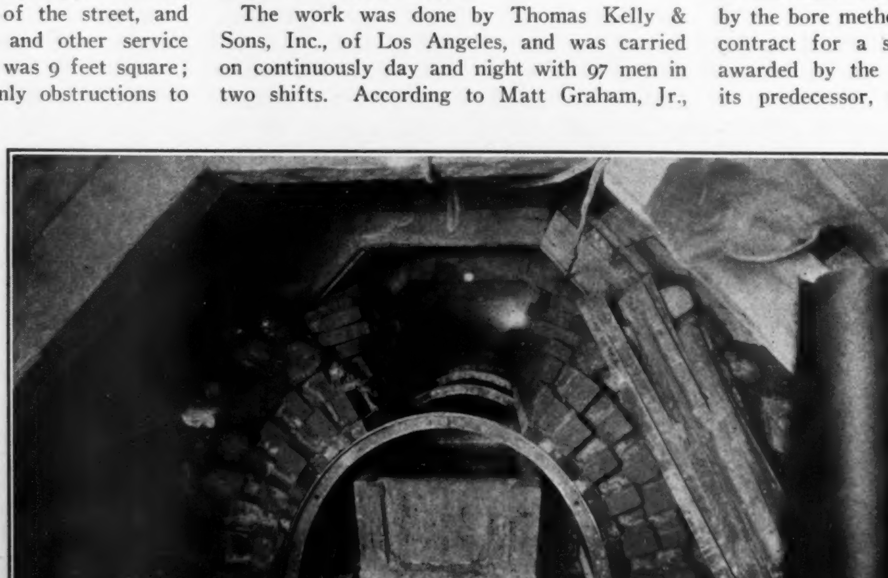
The tunnel has a length of 5,575 feet and a width of 6 feet, and every 1,000 feet throughout the route a shaft was sunk to the working level. This was at a depth of approximately 22 feet below the surface of the street, and well below the gas mains and other service lines. Each of these shafts was 9 feet square; and they represented the only obstructions to traffic throughout the entire length of the sewer.

The tunneling was done almost entirely with air jacks, which were operated with air at 100 pounds pressure supplied by a compressor placed on the street and close to the opening of the working shaft. From this shaft the tunnel was advanced in opposite directions—the air being carried to the headings by 2-inch iron piping. As the digging progressed, the piping was extended to a maximum length in each direction of 500 feet. At the working faces, the air was fed to the pneumatic jacks by suitable hose connections.

The earth encountered consisted of decomposed granite and a sticky clay; and, as it was excavated, it was hauled by small cars, running on tracks, to the working shaft. Thence it was hoisted surfaceward and dumped into waiting trucks. In this manner the muck was disposed of with the least disturbance to surface traffic. Two sizes of relief sewer were built—one of 4 feet 9 inches and the other of 3 feet 3 inches—having a brick top and a semi-elliptical concrete invert.

The work was done by Thomas Kelly & Sons, Inc., of Los Angeles, and was carried on continuously day and night with 97 men in two shifts. According to Matt Graham, Jr., engineer in charge of operations for the contractor: "The whole job was worked out on a unit basis with a schedule that ran like a clock. Our greatest problem was in seeing to it that materials enough were on hand at all times to keep the crews going—it being stipulated by the city that we could stock supplies for only 24 hours in advance."

Speaking of the method by which the relief sewer was built, Mr. Graham continued: "One has only to contrast this tunnel operation with the open-cut method to be amazed at the tremendous saving in time and absence of surface confusion. Tunneling for work of this class is not more expensive than open cuts, because work can progress without delay due to street disturbances or climatic conditions; and the saving to business along the route is measured in thousands of dollars. So successful has been the undertaking that much future work of the kind will, in all probability, be done by the bore method." As proof of this, another contract for a similar project has just been awarded by the City of Los Angeles. Like its predecessor, this tunnel is to be driven largely with air jacks.



© Dwyer Studio.
Sanitary masonry-and-concrete storm sewer while under construction in the heart of busy Los Angeles.

The sewer job cost the city about $168,000; and so quietly was the work done and so little was traffic interfered with that hardly anyone, save those immediately concerned, knew that anything unusual was going on a score and more feet beneath some of the town's busiest streets. On this undertaking the City of Los Angeles was represented by John C. Shaw, City Engineer; F. A. Batty, Construction Engineer; and W. H. Pinkham, designer, all of whom were of material assistance to the contractor.

A cable dispatch from Brussels announces that oil has been struck in the Belgian Kongo.

Fifth Annual Carbuilding Contest of the Delaware and Hudson Company

By BIRGER TINGLOF

BY rebuilding a standard 85,000-pound, twin-hopper gondola railroad car in slightly less than 42 man-hours, the Colonie-Green Island team of the Delaware & Hudson Company recently lowered the existing record achieved in reconstructing a car and displayed an efficiency in workmanship that was considered impossible of attainment a few years ago.

"Feed 'em to us faster!" Joseph Gowacte and Nicholas Polinski, of the Colonie-Green Island team, driving rivets with the aid of a dolly fitted with a recoil spring.

The feat was accomplished during the fifth annual contest of the kind sponsored by that railroad. It was held at the Colonie, N. Y., shops of the line. In addition to the winners, who represented the Saratoga division, teams competed from Carbondale—the Pennsylvania division—and from Oneonta, the Susquehanna division. Each team was made up of eight steelworkers and six woodworkers. The contest involved the reconstruction from the ground up, of a car complete in every detail. The steelwork was punched, ready for erection, but all the other operations were performed just as is the case in everyday routine.

The steel underframe, superstructure, and trucks were rebuilt; draft gears, couplers, and brake rigging were assembled and applied; and all other construction details were completed. The work on each car required the driving of 1,429 rivets, which involved the preparatory use of 254 fitting bolts. There were also used 778 other bolts. A total of 1,403 holes were reamed; and 105 gains were made. Altogether, 190 steel parts and 246 pieces of lumber were assembled—all in accordance with blueprint specifications.

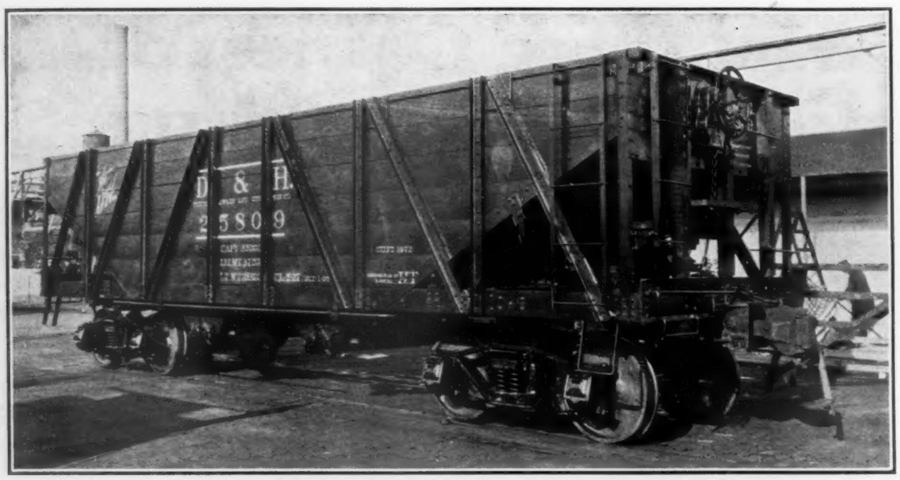
The utilization of compressed air was an important—even vital—factor in the operations of the three teams. In fact, the winning team attributed its victory to the time saved by the use of a portable truck with an air-driven hoist. This hoist quickly and effectively raised and then held in place the structural-steel side frames after they had been riveted in a flat position on top of horses. The employment of "shop kinks" of this kind was permissible under the rules, as it is the practice to permit each team to supply its own tools, including special apparatus of its own devising.

Air-operated tools were used for reaming holes in steelwork, for driving rivets, for boring wooden sides and floors, and for running up all nuts. The oil forges, employed to heat the rivets, also called for the use of compressed air. The pneumatic tools with which the victorious team was equipped consisted of Ingersoll-Rand 8A hammers for riveting, BS and 2S drills for reaming, and DD woodboring machines for boring holes and for running up nuts. The steelworkers of the winning team were organized into two riveting gangs—each consisting of one riveter, one bucker, and one heater—and into one reaming gang of two members.

The contest attracted wide attention, and was witnessed by approximately 1,000 persons. These included representatives of 22 railroads, drawn from points as far removed as Texas, Michigan, and Tennessee. In the five years that the contest has been held it has become a recognized fact that the competition is of great educational value; and the officials of the Delaware & Hudson Company consider it well worth while as a means of improving carbuilding practice and shop efficiency.

To those concerned, the contest is a sporting event of no small importance. The teams work within a roped enclosure, flanked by a grandstand for the accommodation of the spectators. Each team has its tools and materials laid out in such a manner that every piece will be close at hand when it is needed. Rules governing the contest are printed in book form, and a copy is given each of the guests. These rules prohibit interference with the work of a team by foremen, inspectors, or other persons, who are

Left—The contest floor, with teams beginning the erection of steelwork.
Right—The woodwork completed. The winning car is the one in the foreground.



The car that was rebuilt in less than 42 man-hours during the contest at the Colonie shops of the Delaware & Hudson Company.

permitted to render assistance only of a supervisory character.

The judges, car-department officials of other railroads, were: J. Gutteridge, general car foreman of the Kansas City Southern, chairman; F. H. Lee, supervisor of freight car maintenance, Baltimore & Ohio; Frank H. Becherer, superintendent of car department, Central Railroad of New Jersey; and J. P. Jangro, divisional general car foreman, Boston & Maine.

The contest was under the direction of G. W. Ditmore, master car builder of the Delaware & Hudson Company. The trophy awarded to the winners for custody until the next contest is the Birkett Memorial Cup, conceived as a tribute to the first car foreman of the road. It was presented by Colonel J. T. Loree, vice-president and general manager of the line, and was received by T. A. Heminway, divisional car foreman, who directed the work of the Colonie-Green Island team. Others responsible for the efficiency of the winners were J. J. O'Keefe, foreman of steel car repairs, and A. F. Burby, foreman of wood car repairs.

The records of the three teams, computed in terms of total man-hours, were:

Saratoga Division, Colonie-Green Island Team.

Steelwork	25 hrs.	12 mins.	39 secs.
Woodwork	16 "	40 "	
Total time	41 "	52 "	39 "

Pennsylvania Division, Carbondale Team.

Steelwork	29 hrs.	31 mins.	11 secs.
Woodwork	17 "	19 "	45 "
Total time	46 "	50 "	56 "

Susquehanna Division, Oneonta Team.

Steelwork	26 hrs.	49 mins.	5 secs.
Woodwork	20 "	58 "	30 "
Total time	47 "	47 "	35 "

NEW SOLDER FOR ALUMINUM

THAT germanium in an alloy form with aluminum may prove useful as a solder for aluminum, is the opinion of a German metallurgist who has been making a study of the rarer minerals in an effort to determine whether they or their compounds possess valuable properties.

Aluminum can be soldered with alloys containing tin or zinc, but joints of this description fail when exposed to moisture. From the viewpoint of corrosion, an aluminum-silicon alloy would be desirable if it had a lower melting point. As germanium resembles silicon both in its physical and chemical properties, it was to be expected that germanium-aluminum alloys would have corrosion-resisting qualities. It has been found that a germanium-aluminum alloy containing 55 per cent. of germanium and 45 per cent. of aluminum melts at 793°F., and is more suitable than any other alloy for use as an aluminum solder.

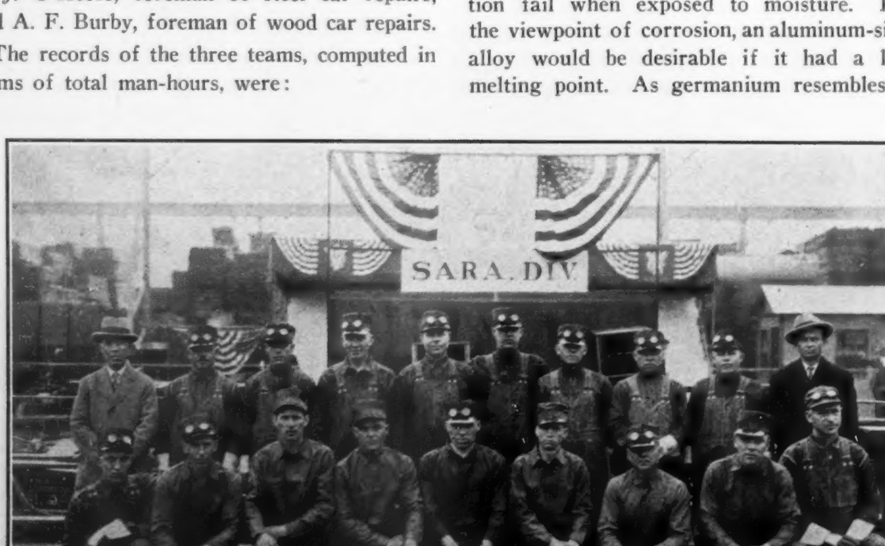
AIR BLASTS MAY MAKE FLYING SAFER

AN aviator's flight is marked by at least two critical stages—the first, when he "takes off," and the second, when he alights necessarily at a high speed. Unlike the motor car, there is no present available braking system that can be employed to arrest the descending aircraft so that its first contact with the earth will be devoid of shock. Therefore, either the wings of an airplane must be made movable so as to offer greater resistance to the air at that moment—much like the wings of a bird function at such a time—or some external braking agency must be devised that will serve the purpose of slowing up the airplane at the critical moment without violence.

To the average person, a successful solution of this problem may seem puzzling; and yet it is highly probable that means are today available that can be adapted for this purpose. To begin with, we have only to recall that the Navy has developed launching apparatus for seaplanes that make it feasible to get these rather heavy flying machines into the air after a short run of about 40 feet. This is accomplished by means of a catapult that consists essentially of a small platform mounted on wheels and traveling along a narrow, double track—the platform or car being drawn forward by a cable running over a number of pulleys that effect very rapid acceleration. The seaplane acquires sufficient speed to "float" in the air when released and catapulted at the end of the runway.

Reversing this procedure, it is now proposed to induce the same lifting action by creating an artificial gale, with rotary blowers, so that the aircraft will have the benefit of this buoyant force immediately upon starting forward to rise from the earth. Anyone that has watched large seabirds and similar creatures, must have noticed how these birds well-nigh invariably head toward the prevailing wind when beginning their flight. It is entirely practicable for man to have recourse to a kindred maneuver by producing artificially a sufficient volume of air moving at a velocity of 50 or more miles an hour.

It requires no stretch of the imagination to grasp the fact that a similar system could be employed at landing fields, or elsewhere, to form, in effect, a pneumatic buffer or brake against which an alighting airplane could be brought to earth without shock and within a much shorter distance than is now possible. Something of this sort has already been proposed; and its adoption will depend on whether engineers can show that blowers of sufficient capacity can be installed and operated at a reasonable cost. The theory is all right, but the price may be too high for wide employment.



Members of the victorious Colonie-Green Island team.

Salt Works at Grand Saline

This Town in Eastern Texas Has Been Producing Salt From An Underlying Dome For More Than Six Decades

By R. G. SKERRETT

IN the course of a single year, we produce in the United States more than 7,000,000 tons of salt, having a value of fully $26,000,000.

This salt comes from a variety of sources: Some of it is mined in the form of rock salt; some of it is produced by solar evaporation from the saline waters of lakes, ponds, and the sea; while much other salt is obtained from deep wells. Apparently, we need never fear a lack of an abundance of salt.

The accompanying story describes the processes used in manufacturing salt from brine drawn from deep wells that tap a salt dome in eastern Texas.

GRAND SALINE, Tex., lies about 65 miles east of Dallas, and is especially noteworthy because it has produced salt for more than 60 years. The salt has been put to many uses throughout the state as well as elsewhere. In the early days of the salt industry at Grand Saline relatively primitive means were employed to deal with the brine, but for fully a quarter of a century the methods utilized have been generally modern.

The source of the salt obtained at Grand Saline is a dome underlying a part of the town. The origin of this dome, as well as that of other salt domes in Texas, was long a matter of speculation among geologists. Some technicists argued that the domes were of volcanic origin; others were equally insistent that the salt was deposited by evaporation from salt water that ages ago flowed from some hypothetical springs. Within recent years, however, the consensus of opinion is that the domes were created by the salt being shoved upward, while still in a plastic state, through the overlying rock—the salt coming from an extremely deep parent bed that was acted upon by tremendous earth forces.

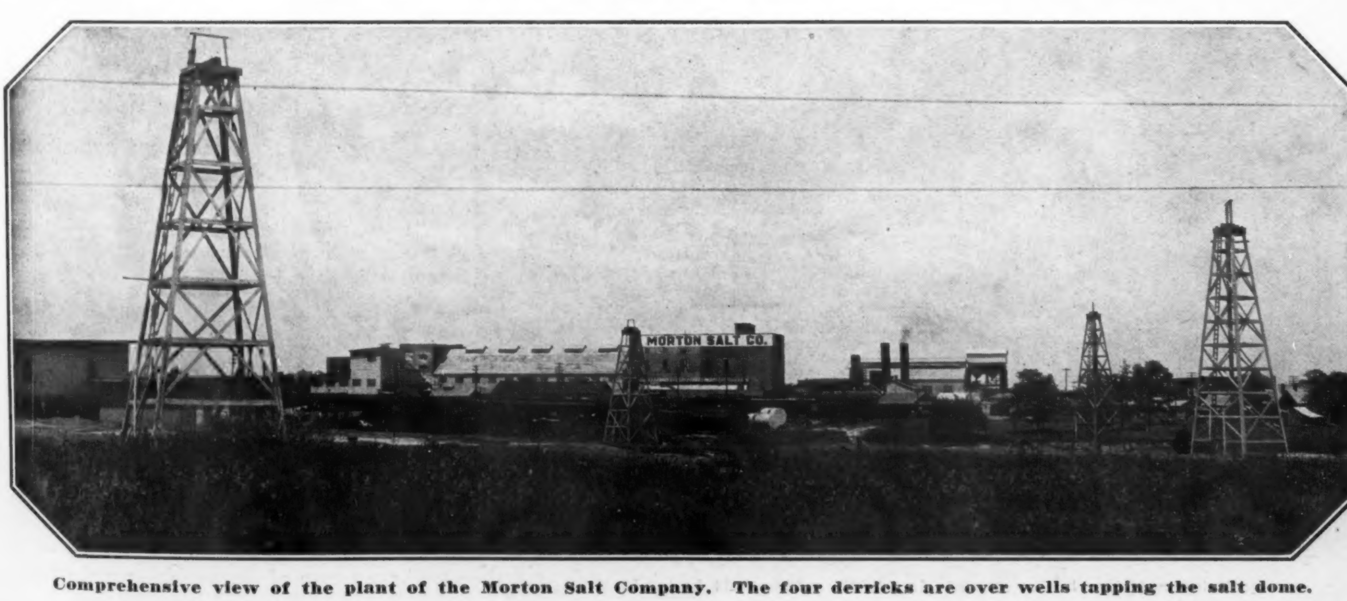
Be that as it may, the salt accumulated and crystallized in pluglike masses that have, in some cases, diameters ranging from half a mile to a mile and a half, and have vertical thicknesses of even more than a mile. Of one thing we can be sure: the domes were called into being many thousands of years ago. At Grand Saline, the rock lying under the salt is, itself, buried beneath a cover of Tertiary sands, clays, and shaly clays having a combined thickness of 180 feet.

Back in the days of the Civil War, salt was obtained at Grand Saline by sinking shallow wells and by boiling the brine in open iron vessels so as to evaporate the surplus water and thus bring about the desired crystallization. Crude as the process was, it was possible then to produce 1,000 sacks of salt a day—each sack holding about 200 pounds of the commodity.

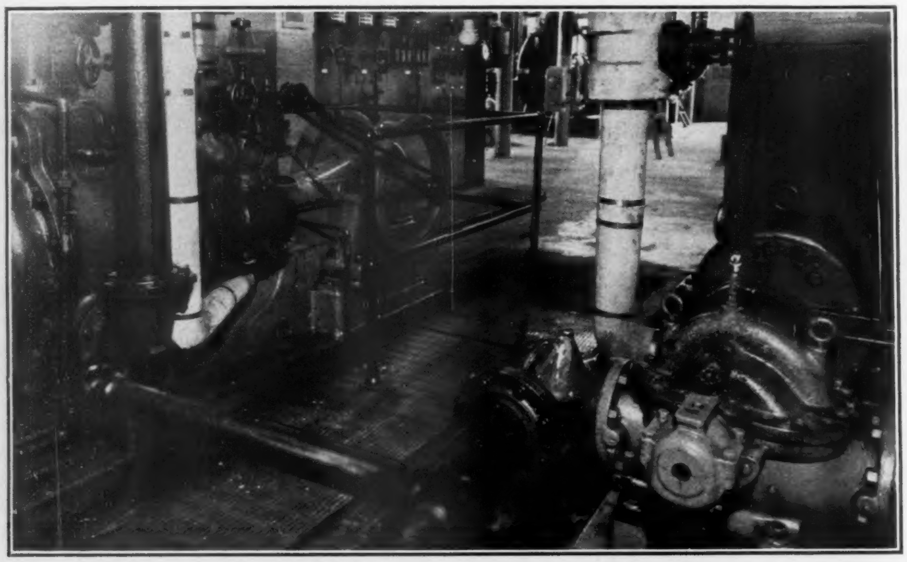
After the Civil War, the business of making salt at Grand Saline dwindled. By 1874 there was only one brine well in use, and from that well an output of something like 50 sacks of salt was evaporated daily. The salt content of the brine was such that 1 gallon of water made 1⅓ pounds of salt; and the salt sold for $3 per sack. Manifestly, the shallow wells carried a much lower percentage of salt than the brines that are now evaporated at Grand Saline. To obtain this brine of greater density it has been necessary to sink the wells to a depth of several hundred feet in order to reach the rock salt in the very heart of the dome. This was not possible in the days when the wells at Grand Saline were shallow ones.

The salt industry at Grand Saline has had its ups and downs ever since the first steam plant was built there in 1888-89. It was then that the first deep well was drilled; and that well yielded 1,000 barrels of salt a day. Other deep wells have since been drilled and worked—most of them being abandoned successively when they failed to furnish brine in satisfactory quantities or when the extraction of the underground salt led to surface subsidence that might entail serious cave-ins. This intermittent failure of the wells was not the only difficulty with which the industry had to contend: as records show, the salt plants built at Grand Saline were destroyed by fire on an average of every five years. Even so, the industry has persisted on a modern basis for more than 25 years; and there is ample warrant for the belief that Grand Saline will continue to be an important source of salt for years to come.

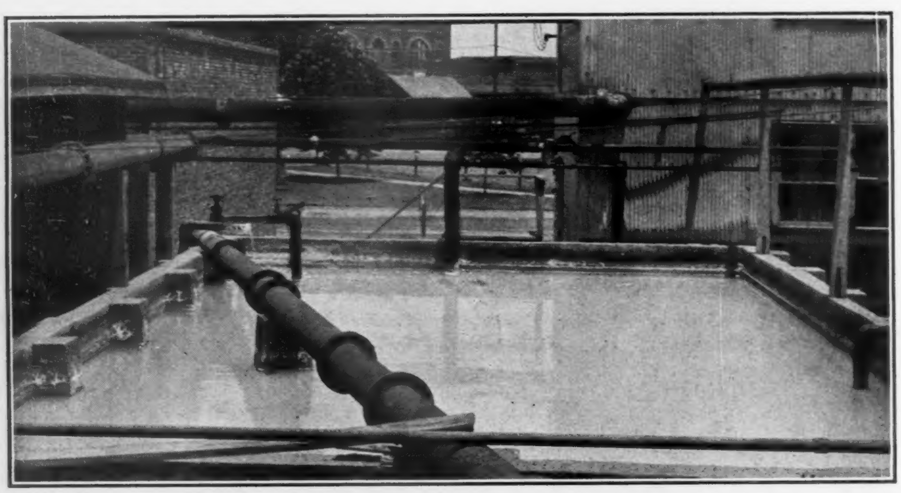
The present up-to-date plant at Grand Saline is owned and operated by the Morton Salt Company; and it is capable of turning out every



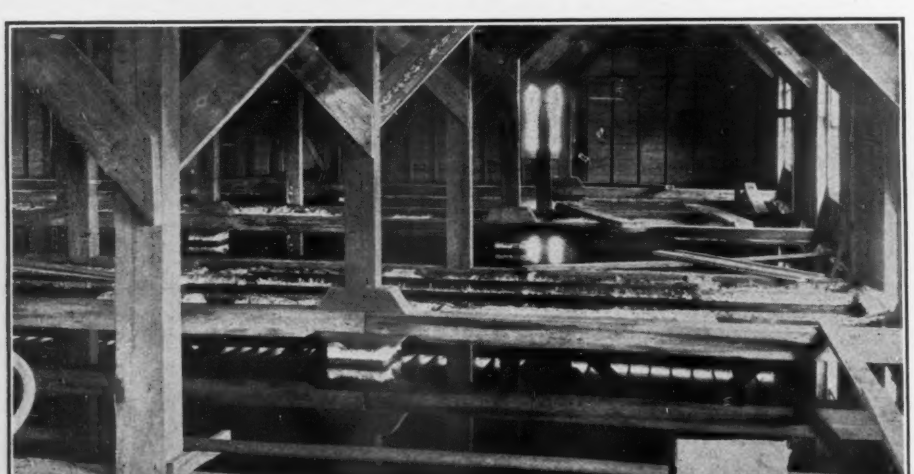
Comprehensive view of the plant of the Morton Salt Company. The four derricks are over wells tapping the salt dome.



Ingersoll-Rand vacuum pump and turbine-driven Cameron pump connected with an I-R condenser.



One of the brine feed tanks from which the brine is pumped to the vacuum pans.



Brine settling tanks or vats in which coarse salt is made.

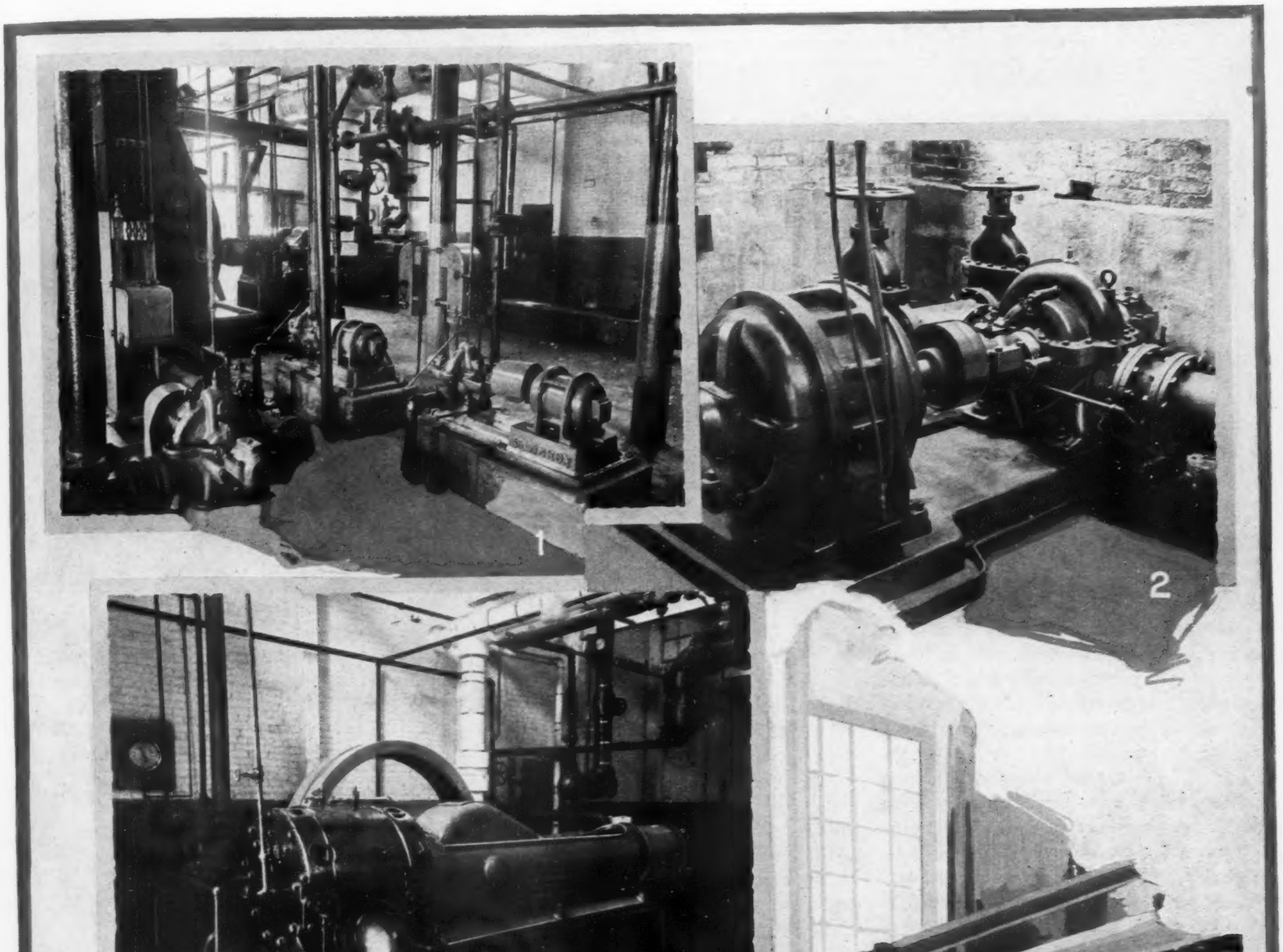
24 hours 2,000 barrels of salt, each barrel weighing 280 pounds. This is equivalent to a production of 280 tons a day. The Morton Salt Company draws its brine from a number of wells, and this brine reaches the mill through a system of 6-inch piping. The manner of operating these wells is somewhat unusual.

The ordinary method of obtaining salt from domes—where the rock salt is not mined directly—is to pump water down into the rock-salt masses for the purpose of dissolving the salt. After that the brine is raised to the surface and evaporated by processes that will yield the desired ultimate product. At Grand Saline a somewhat different procedure is employed. There, the needful water comes from an underground water-bearing stratum lying at a depth of approximately 200 feet. This water is diverted downward into the underlying salt body of the dome, and the resultant brine is forced up to the surface by means of air pressure applied above the water column. The brine obtained in this way has a salt content of nearly 28 per cent. Let us describe a typical well, of which there are six at Grand Saline, from which the Morton Salt Company draws its brine.

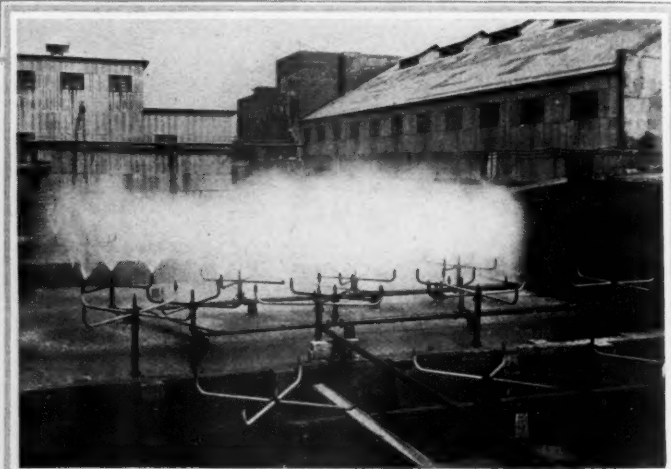
The well was drilled with a star drill to a total depth of 409 feet. For 114 feet downward the well has a 10-inch casing, and for the succeeding 188 feet the well is fitted with an 8-inch casing. This casing penetrates 150 feet into the rock-salt formation, and is sealed tight where it passes through the shale that lies above both the water-bearing stratum and the rock-salt mass. Within the casing there is a 4-inch brine line extending to a depth of 374 feet; and also within the casing there is a compressed-air line, formed of 1¼-inch piping, that reaches downward for a distance of 284 feet. When air pressure is applied within the casing it serves a twofold purpose: first, to circulate the water which it forces downward and, second, to impel the resulting brine surfaceward—whence the brine flows onward to settling tanks in which any suspended solid matter is precipitated before the brine goes into the mill for evaporating. Lime water is added to the brine at the settling tanks to hasten the desired precipitation. When the settling is finished, the brine is pumped to the brine feed tanks from which it is delivered either to vacuum pans or to open pans or vats, depending upon the nature of the final product desired.

The Morton Salt Company employs vacuum pans in the making of table salt, dairy salt, and salt that is pressed into blocks for cattle feed; and it uses open pans or vats in producing what is known as grainer salt—that is, a coarse-grained salt that is widely utilized by meat packers in preserving their commodities.

In the distribution of the brine it is essential that pumps be employed which can withstand the corrosive action of the brine and which can be counted upon to give the fullest measure of service with the least amount of overhauling. To this end, the plant is equipped with numerous centrifugal pumps of a well-known type of thoroughly proved efficiency.



1—Cameron pumps that distribute the brine in the plant.
2—Motor-driven Cameron pump that delivers water to the spray pond.
3—Ingersoll-Rand steam compressor that furnishes air to operate the air lifts on the brine wells.
4—Turbine-driven No. 8 Cameron pump handling brine.
5—Turbine-driven and motor-driven boiler feed pumps that take care of the water for the steam plant.

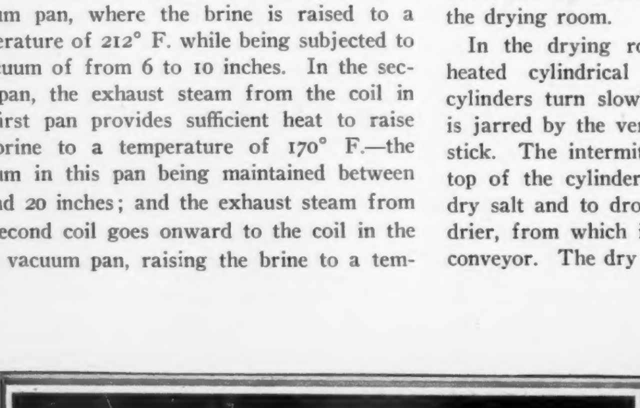
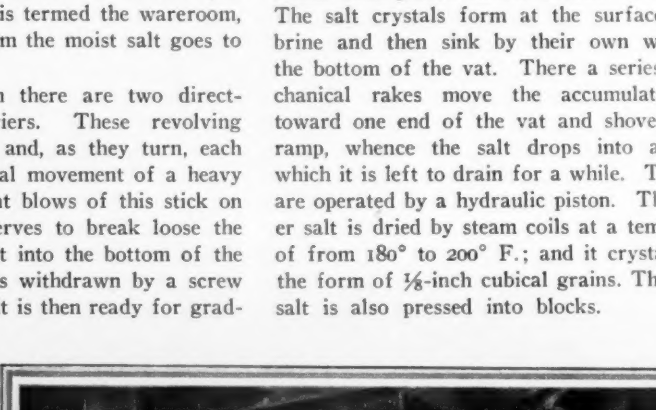
**Left—How the salt looks when ready for packing.
Right—Spray pond where hot water is cooled for re-use.**

The plant has an installation of six large vacuum pans—three pans forming a battery and working in combination in obtaining a triple evaporating effect. Each battery of three vacuum pans is capable of making 950 barrels of salt during a 24-hour day. The pans forming a battery are inconnected so that the vapor produced by the first pan passes onward to the second pan, and the vapor from the second pan goes into the third pan. This arrangement, in combination with the vacuum used in each pan, makes it possible to obtain the fullest practicable vaporizing effect of the initial live steam which is delivered only to the coil in the first vacuum pan, where the brine is raised to a temperature of 212° F. while being subjected to a vacuum of from 6 to 10 inches. In the second pan, the exhaust steam from the coil in the first pan provides sufficient heat to raise the brine to a temperature of 170° F.—the vacuum in this pan being maintained between 15 and 20 inches; and the exhaust steam from the second coil goes onward to the coil in the third vacuum pan, raising the brine to a temperature of 130° F. in the presence of from 26 to 29 inches of vacuum. As most of us are aware, the higher the vacuum the lower the boiling or vaporizing temperature.

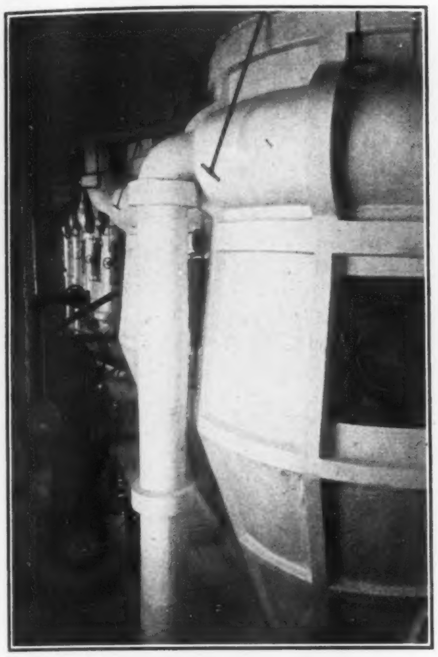
Thus, successively, the water of the brine is boiled away so as to concentrate the liquor and to induce the crystallizing and the precipitation of the contained salt. As the salt accumulates in the boot at the bottom of each vacuum pan it is removed by a belt conveyor which elevates the wet salt and delivers it to the draining bins. From the draining bins the salt is carried by a belt conveyor to what is termed the wareroom, and from this wareroom the moist salt goes to the drying room.

In the drying room there are two direct-heated cylindrical driers. These revolving cylinders turn slowly, and, as they turn, each is jarred by the vertical movement of a heavy stick. The intermittent blows of this stick on top of the cylinder serve to break loose the dry salt and to drop it into the bottom of the drier, from which it is withdrawn by a screw conveyor. The dry salt is then ready for grading and packing or for pressing into blocks, as the case may be. The Morton Salt Company produces four grades or kinds of block salt for cattle feed—that is, two white and two gray grades—sulphur being mixed with some of these. The table salt is of what is known as the "free-running" salt, and is packed in suitable cartons or bags for home use.

In making the coarse-grained salt for meat packers the brine is evaporated in large open vats, where the saturated solution is heated by steam coils placed at the bottom of the vats. The salt crystals form at the surface of the brine and then sink by their own weight to the bottom of the vat. There a series of mechanical rakes move the accumulating salt toward one end of the vat and shove it up a ramp, whence the salt drops into a bin in which it is left to drain for a while. The rakes are operated by a hydraulic piston. The grainer salt is dried by steam coils at a temperature of from 180° to 200° F.; and it crystallizes in the form of ⅛-inch cubical grains. This coarse salt is also pressed into blocks.

**Left—Press in which salt is formed in blocks for cattle feed.
Right—Centrifugal driers that remove much of the moisture from the salt in one stage of preparation.**



A battery of big vacuum pans that concentrate the brine and induce precipitation of the salt crystals.

The compressed air used by the Morton Salt Company is furnished by an XPV-2 compressor having a piston displacement of 1,877 cubic feet per minute. Besides serving to pump the brine wells, this air is employed to clean electric motors and to operate certain of the filling machines, or to aid those machines by shooting and reversing the empty containers so that they can be sealed at one end, filled with salt, and then sealed at the other end. Compressed air is further utilized about the mill to drive pneumatic drills, chippers, and hammers for one purpose or another.

Centrifugal pumps are used at the plant not only to circulate the brine but to handle boiler feed, to deliver water to the condenser, to pump condensate, to provide water for washout purposes, to pump the boots of the vacuum pans, and to deliver hot water to the spray pond. In short, the pumping plant is a very important part of the mechanical equipment of the mill. The vacuum necessary for operating the six big vacuum pans is supplied by an FR-1 vacuum pump.

In effecting the rapid evaporation of the large quantities of brine handled daily much steam is required, and this steam is raised by burning lignite that is mined at Alba, about nine miles away from Grand Saline. This fuel, which costs the Morton Salt Company $2 a ton, is decidedly efficient; and substantially 150 tons are burned in the plant every 24 hours. This fuel is generally utilized throughout Grand Saline. The Morton Salt Company is more than the dominating industrial activity within the town: it is a public utility, because it is the source of the electric current that is used for lighting purposes in the community.

DRIVING A TRUCK WITH NATURAL GAS

ONE of the interesting features at the recent convention of the Natural Gas Association of America, held in Cincinnati, Ohio, was an automobile truck that was operated with natural gas instead of gasoline. With the exception of a few alterations in the carburetor, and the substitution of a gas tank for the gasoline tank, no changes in design were necessary.

During a total run of 147.2 miles, covered while the convention was in progress, the truck consumed 1,461.42 cubic feet of natural gas. Based on heat units, and with gas at 75 cents per 1,000 cubic feet, it cost .75 cent a mile to drive the truck with natural gas, or 1.25 cents less than it would have cost had gasoline, at 20 cents a gallon, been used.

SAVING FURNESS ABBEY BY GROUTING

By NORMAN BERLING

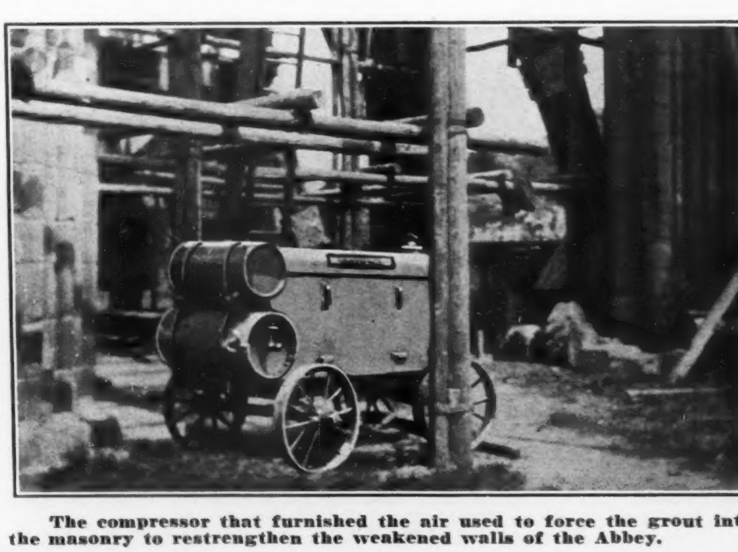
AN interesting contrast of the old and the new is brought out in the accompanying pictures illustrating the work being done by modern machinery to preserve an ancient abbey in the north of England. Furness Abbey is beautifully situated in a wooded valley near the great shipbuilding town of Barrow-in-Furness, and is one of the finest and most famous of the numerous historic structures of this kind to be found in the British Isles.

Furness Abbey was founded and dedicated to St. Mary in 1127 by a small body of monks belonging to the Benedictine Order of Savigny. Subsequently, as a result of a succession of substantial donations, the Abbey not only became one of the richest but also the largest Cistercian foundation in the kingdom. The structure is a fine example of transitional Norman and Early English architecture, and is built of a warm red sandstone that adds to the picturesqueness of the ruins. These are extensive and, for the most part, in an excellent state of preservation.

A picturesque vista through the portal of the vestry of Furness Abbey.

It is to offset the ravages of time and to keep these ruins substantially in their present condition that efforts are now being made to prevent the further collapse of sections of the edifice that have latterly shown signs of crumbling. The transept, especially, has been in danger of falling, as the mortar binding the sandstone has more or less disintegrated. To again firmly cement the loosened stonework, grout applied under pressure is being forced to refusal into the interstices in the walls by a cement gun. Compressed air for the operation of this gun is supplied by an I-R portable compressor.

That Britain is intent on preserving her famous monuments of centuries gone for the enjoyment of future generations is evidenced by work of a kindred nature that has been and is being done in restoring Lincoln Cathedral, Durham Castle, and St. Paul's of London.



The compressor that furnished the air used to force the grout into the masonry to restrengthen the weakened walls of the Abbey.

The 1927 expenditures on highways in the Province of Alberta, Canada, will amount to $1,200,000. Of this sum, $1,000,000 has been appropriated for new construction and $200,000 for maintenance. A 12,000-mile system of market roads has been planned to connect the main communities throughout the province; and on this work $400,000 will be spent this year.

It is proposed to heat the entire City of Reykjavik, the capital of Iceland, with water from the island's noted hot springs. Leaving the wells under pressure and above the atmospheric boiling point, the water can be delivered through pipes to the consumers' radiators hot enough for the purpose mentioned.

Big Irrigation Project in Algeria

By F. A. CHOFFEL

THE Government of Algeria, a French possession on the north coast of Africa, has initiated a twofold program to bring about the irrigation of vast expanses of semi-arid land. Along the southern boundary, adjoining the Sahara Desert, wells are being drilled to tap water-bearing strata. In northern sections of the country, dams and diversion canals are being constructed to impound and to distribute the great flow of flood water that now makes its way unchecked to the sea. The fruition of these plans will bring thousands of acres of fertile soil under cultivation: it will insure the belated agricultural development of a region which, throughout history, has been largely a forebidding spot on the map peopled in the main by nomadic Arabs.

Despite the fact that it is not remote from those areas which produced "the glory that was Greece and the grandeur that was Rome," Algeria has come down through the centuries little changed from the days of the Ptolemies. Merchant vessels, from the galley ships of restricted range to the world-cruising steamers of today, have seldom had cause to touch its shores. So little has it been explored that some of its boundaries are even today undetermined.

Algeria is roughly rectangular in surface outline, measuring some 650 miles by 300 miles and having its longest dimension in an east and west direction. Its coast line is for the most part bleak and uninviting. Mountains rise sheer from the water's edge or just behind a narrow fringe of beach. Natural harbors are infrequent. In only a few places have streams widened out their lower valleys into coastal plains. These occasional stretches of lowland have been intensely cultivated; and some famous gardens, like those of Mitidja, near Algiers, have resulted.

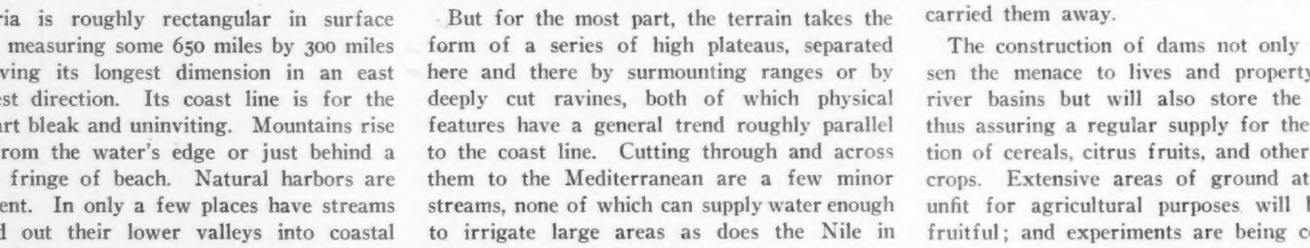
Assembling the air line by which the necessary compressed air is to be carried to the various points of use.

But for the most part, the terrain takes the form of a series of high plateaus, separated here and there by surmounting ranges or by deeply cut ravines, both of which physical features have a general trend roughly parallel to the coast line. Cutting through and across them to the Mediterranean are a few minor streams, none of which can supply water enough to irrigate large areas as does the Nile in Egypt, farther to the East.

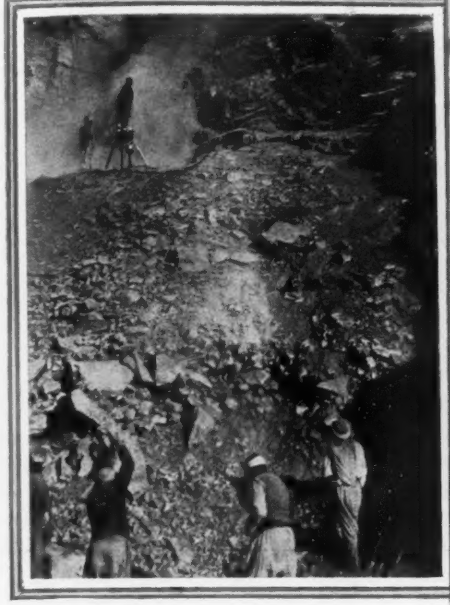
These table-lands or mesas are suitable for the growing of crops, and will become highly productive when ample water is made available. Even now, in the Betif region, grain is grown more or less successfully at altitudes above 3,000 feet when the rainfall is sufficient during the growing season. Rain is abundant in these sections of the country not only in the rainy season, from January to March, but also in the spring, fall, and even in the summer. There is no assurance, however, that the moisture will come when it is most needed. Furthermore, the character of the storms is such that the benefits to be derived from them are short-lived.

The rains are torrential. They literally throw millions of cubic feet of water upon the ground. Substantially all of it is lost through infiltration or a rapid run-off to the sea. The normally dry *oueds,* as the Arabs term the river beds, suddenly become carriers of tumultuous streams raging through the gorges which have been cut during past ages. These downpours are so abrupt and so violent that numerous persons—unable to flee the rapidly rising waters—are caught by them and drowned each year. The floods subside as quickly as they appear; and engineers who hurry forth to repair the damage to bridges very often find no trace either of the bridges or of the waters that carried them away.

The construction of dams not only will lessen the menace to lives and property in the river basins but will also store the water—thus assuring a regular supply for the cultivation of cereals, citrus fruits, and other suitable crops. Extensive areas of ground at present unfit for agricultural purposes will be made fruitful; and experiments are being conducted looking towards the establishment of cotton plantations. Considerable progress has already been made in this direction. The dams will furthermore be available for the generation of



General view across the canyon of the River Fodda, showing construction camp and some phases of the work.



Left—Blowing out a drill hole with compressed air.
Center—An X-70 drill mounted on a derrick or tower for deep drilling. Holes up to 60 feet in depth are drilled from this set-up.
Right—Changing the steel of an X-70 drill mounted on a tripod. The drill steel being put in place is more than 30 feet long.

electric power, a form of energy which should be especially valuable in a country lacking entirely in either organic or inorganic combustibles.

Although the government is handicapped because of limited credits, it is prosecuting its scheme of reclamation with all possible dispatch, and good headway is being made. In the south, borings have located some heavy subterranean water flows; and as the wells are frequently artesian in character it is unnecessary to install pumps. Many of these borings have been made with David "Calyx" core drills, which have proved satisfactory for the work.

The policy being pursued in the north calls upon the ever-dependable compressed-air rock drill to drive tunnels, to excavate for dam footings, and to quarry the rock which forms one of the principal materials of dam construction. At the present time work is underway on a dam and related structures on the *oued* Fodda, near Orléansville, in the Department of Algiers. The plans for this project were prepared by the engineers of the Department of Public Works of Algeria, and the contract was awarded to La Société Dufour, general construction contractors of Paris.

The plans call for the driving of two tunnels for the diversion of the waters of the Fodda River, for the building of a high-water outlet canal, and for the construction, in a gorge, of a masonry dam more than 300 feet high and varying in length from 235 feet at the base to 535 feet at the top. The work also involves the quarrying of the rock required for the masonry dam. More than 400,000 cubic yards of masonry will be placed in the dam; and the excavations for keying the foundation in the side walls and the bottom of the gorge involve the removal of 130,000 cubic yards of material. The impounded waters will form a reservoir with a capacity of 241,965 acre-feet and will cover an area at high water of 1,900 acres.

It is significant to note that, in a country whose development has lagged for centuries, the work is being prosecuted with the same dispatch that might be expected in the United States. With a total labor force of 250 men, it is estimated that operations will be completed within three years from the date of commencement. Modern construction methods prevail, and the best-available equipment is being employed. Compressed air is taking the place of man power in performing many tasks. Air-driven rock drills of American manufacture are relied upon to put in the holes preparatory to blasting the rock. For heavy drilling, "Leyner-Ingersoll" X-70 drills are used. For blockholing and for general drilling purposes, "Jackhamers" of the BBR-13 and BAR-33 types are employed. A "Leyner" No. 4 sharpener serves to recondition the drill steels.

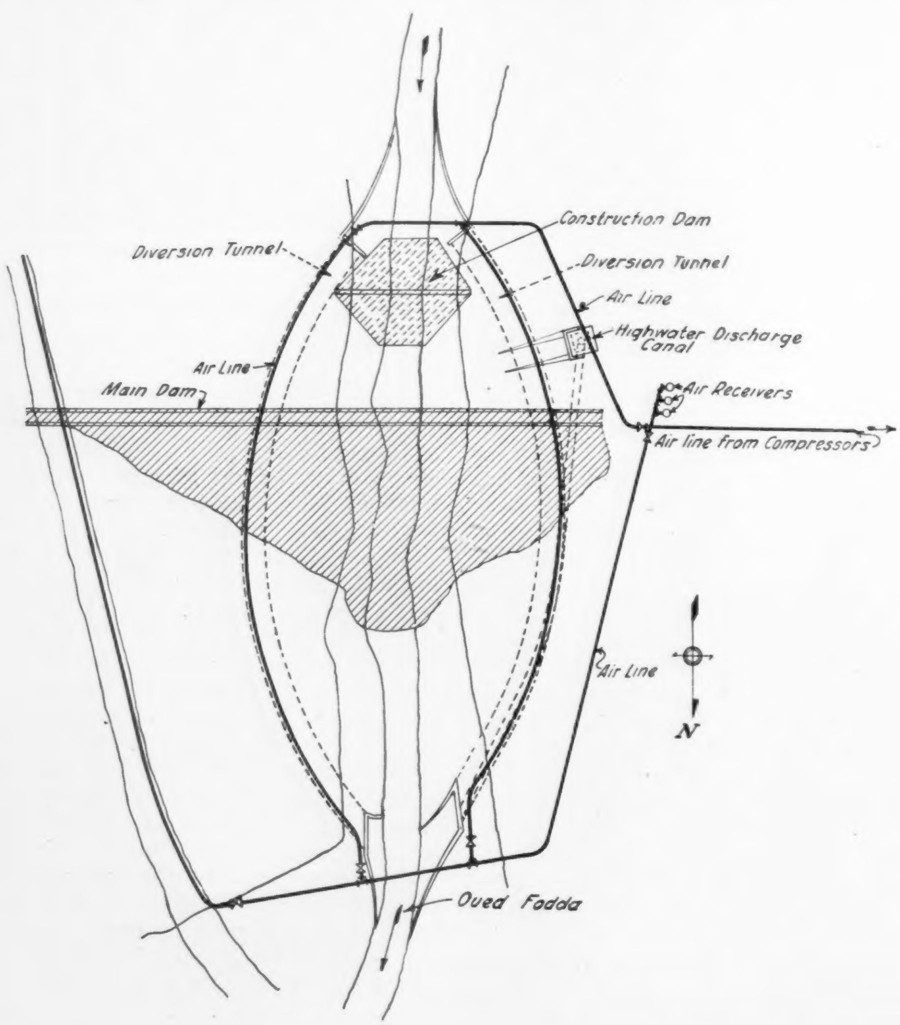
The rock encountered is a hard blue limestone. The drilling problem is complicated because of irregular stratification and the presence between the limestone beds of bands of clay and marl in which the drill steels tend to stick. Despite these difficulties, however, excellent progress is being made; and large-size, vertical holes are being driven to depths of from 40 to 70 feet. These holes are being sunk in a quarry near the dam site. For this work, 25-foot towers are used—the drill being suspended by means of a "slab back" which moves up and down in the grooves of the tower. Not only are the vibrations of the drill thus lessened but the drill is given sufficient weight to insure rapid penetration.

The combined compressor house and blacksmith shop equipped with an I-R oil furnace and a drill-steel sharpener.

Standard cross bits on 1¼-inch hollow round steels are utilized; and holes varying in diameter from 3 to 3¾ inches are drilled. Because of the high quality of the steel and of the process of hardening and tempering that is employed, it is possible to drill a hole 60 feet deep without changing the bit. The drill rod is also composed of 1¼-inch hollow round steel. As the hole is deepened, the rod is lengthened by the addition of sections that are provided in lengths of 1, 3, 6, 10, 16, and

20 feet, thus making available sections suitable for use in any depth of hole. The sections are joined by means of threaded couplings. The type of this thread has been the subject of especial study, which has resulted in a thread that permits of easy tightening and unscrewing and that does not work loose while drilling is in progress. This thread is of a trapezoidal cross section, with its contact edges slightly rounded.

Immediately below the hammer of the drills, at the shank end of the drill rod, is a special air or water head, according to whether wet or dry drilling is practiced. While the drills are equipped to operate either with or without water injection, the best results are obtained by dry drilling. This is due to the fact that water tends to form mud in the softer strata, causing the drills to stick.



In compact limestone, a drilling speed of from 10 to 15 feet per hour is easily attained. In the irregular formations, where clay and marl are encountered, it has been possible, despite these difficulties, to drill 60 feet in less than 10 hours—including the time required to frequently clean the holes. This latter operation is accomplished without trouble. In excavating the sides and the bottom of the gorge to provide an anchorage for the dam, the X-70's, mounted on tripods, drill holes from 20 to 30 feet deep. These holes are generally parallel to the gorge wall—that is, on a slope of 60 to 70 degrees.

Economical extraction of the material drilled is made possible by the use of liquid oxygen, which constitutes the explosive. A plant for its manufacture is installed at the point of operation.

OIL-SHALE PLANT FOR MANCHURIA

IN AN earlier issue of this Magazine we described the experimental work being done by the South Manchuria Railway Company in developing the vast oil-shale deposits lying some 33 miles east of Mukden. Since that time considerable progress has been made, and this should prove of interest in view of the ever-increasing demand for fuel oil.

In October of 1926, the small 10-ton test furnace was abandoned for a furnace having a daily capacity of 50 tons. As a result, 95 per cent. of the oil in the shale is now extracted instead of 80 per cent.; and the output of by-product sulphate of ammonia has been increased from 21 pounds to 25 pounds per ton. "The oil content of the shale," writes United States Consul M. S. Myers, at Mukden, "ranges between 0.3 and 13 per cent., the average being between 5 and 6 per cent. It is a paraffin-base oil, claimed to run from 8 to 10 per cent. paraffin. According to engineers, the oil as extracted—that is, without refining—can be used for Diesel engines. The statement has been made that the 40-ton furnace can treat easily 43 tons of shale a day."

The plan is to install 50 furnaces of this type in a plant, which is to be completed within three years. On the basis of a 5 per cent. oil content, this plant will have an annual output of 35,000 tons of heavy oil. Besides, there would be produced 7,000 tons of sulphate of ammonia and 4,000 tons of paraffin.

PORT OF LIVERPOOL SOLVES OIL-POLLUTION PROBLEM

THE regulations of the Mersey Docks & Harbor Board, which controls the Port of Liverpool, require that the cleaning and flushing of oil tanks by direct discharge into sea water be carried out in a specified area some 65 miles from Liverpool. This restriction, though necessary, has placed a great handicap on operations in the port and particularly on the ship-repairing yards in the Mersey. Before a tanker could be dry-docked for repairs it had to be taken to the distant dumping area and there have its tanks flushed and steamed in the manner prescribed in order to obtain the inspection certificate stating that the tanks were free from gas.

To overcome this difficulty, two oil-separating steam barges have been constructed, and these make it possible to do the work right in the harbor without polluting the water. One of these, the *Oil Separator*, is used in connection with the ship-repair yards. This vessel may also be hired by tankers unloading at Liverpool. It is 126 feet over all, and is capable of handling 200 tons of oil and water per hour. The other craft, the *Xanthus*, was built for Messrs. Alfred Holt & Company, owners of the Blue Funnel Line, for their steamers. The *Xanthus* is 102 feet in length, has a breadth of 22½ feet, and a depth of 10 feet. Both of these oil-separating barges operate on the same principle.

The water used for flushing, or as ballast in the tanker, is pumped from the ship into the barge, where it is passed and repassed over a series of perforated baffle plates until sufficiently freed from oil to be discharged into the harbor. A considerable amount of oil is recovered in this process.

It is reported in *The Engineer* that a new road-covering substance has been invented by a Swedish Engineer, Mr. John Behmer. It is claimed that the coating—the main component of which is bitumen—has four times the resistance of the ordinary asphalt covering at 122°F. The surfacing material is applied under high pressure by a machine, not unlike a steam roller, that can cover an area of 6,889 square yards in eight hours.

It has been estimated that the River Shannon, when the present work of hydro-electric development is completed, will provide energy to generate 165,000 hp. of high-tension alternating current. This current is to be transmitted to about 200 transformer stations throughout the Irish Free State.

Monster Organ in Mormon Tabernacle

Its Thousands of Pipes Are Made Vocal With Compressed Air Supplied By Power-Driven Blowers

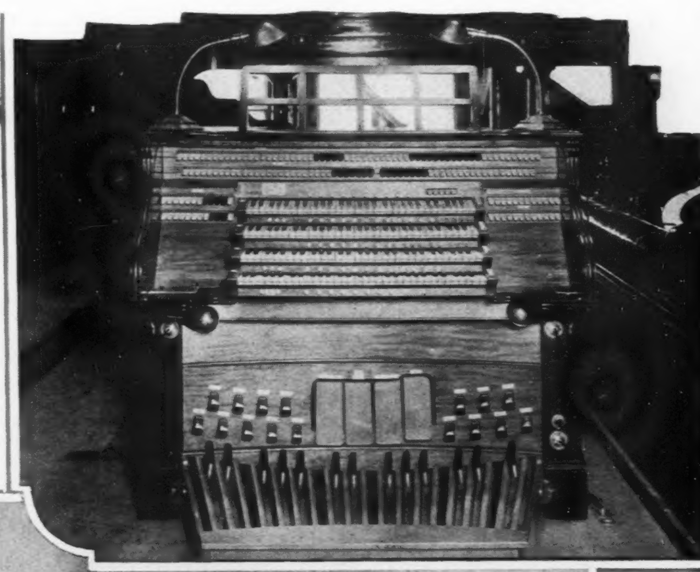
By GAIL MARTIN

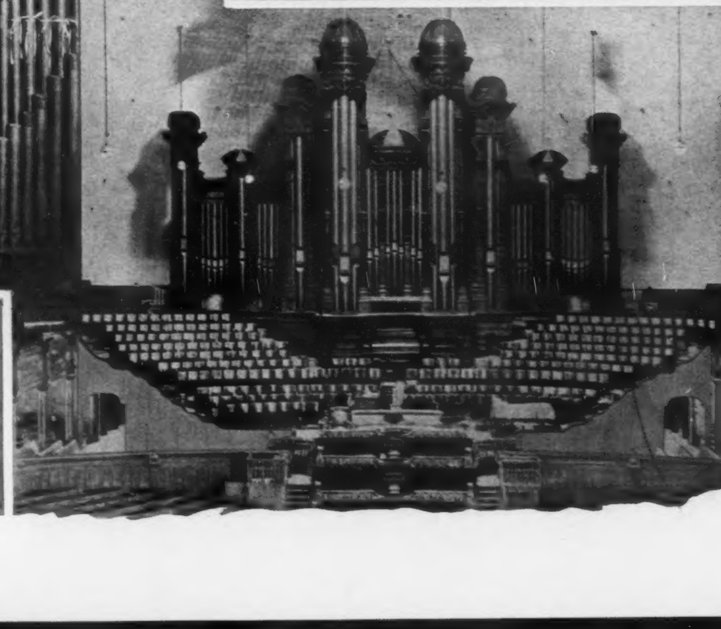
COMPRESSED air has invested man with the power of evoking sounds of amazing range and tonal quality. Expressed differently, compressed air has contributed much towards perfecting civilization's mightiest musical instrument, the organ. The beginning of the organ reaches far back into antiquity. Ctesibius of Alexandria, who lived in the third century before Christ, invented a mechanically blown trumpet and is said to have extended this idea to the operation of a row of musical pipes. From that somewhat primitive beginning has descended the modern organ which, with its thousands of pipes and miles of wood and metal tubing harnessed to electricity and blown with compressed air, possesses tremendous power as well as marvelous diversity of effect.

For many years after the world's masters had composed for the organ some of the greatest music ever written, the action and the accuracy of the instrument were hampered by inadequate air apparatus. Today, these difficulties have been completely overcome by compressed-air equipment. No longer do the organist and the bellowsman have to rehearse together so that the latter may know where the heaviest passages occur and where to put forth the greatest effort, neither is the organist haunted by the fear that noble climaxes may be ruined and the risibility of his audience aroused when crashing chords suddenly collapse and dissolve into groanings—thus proclaiming that the organ is gasping for breath.

Probably the great organ in the Tabernacle of the Church of Latter Day Saints of Jesus Christ at Salt Lake City, Utah, affords as interesting an example as any of what improved compressed-air equipment has done for this type of musical instrument. This organ is acknowledged to be one of the finest and largest in the world. During the past 60 years it has successively gone through the various stages that have marked the advance in power development. It symbolizes the first yearning of the western pioneer for culture; and its improvement is indissolubly linked with the growth of a rich and prosperous commonwealth.

Reaching what is now Salt Lake City on July 24, 1847, after a dangerous and toilsome trek over the western plains, the Mormon pioneers had all they could do during those first few years to keep body and soul together. Food had to be provided for a population that was continually augmented by the arrival of additional weary, travel-worn immigrants. Plowing had to be done, seed planted, irrigation ditches dug, dwellings built, a city laid out, and a desert made fruitful. Nevertheless, the pioneers did not lose sight of their motive



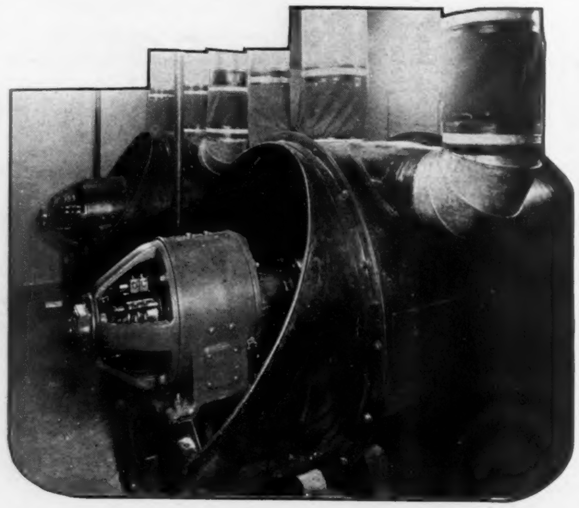


Above—Pipes of the orchestral organ.

Top—Keyboard or console of organ.

Bottom—Tabernacle organ as it looks today after thorough modernizing.

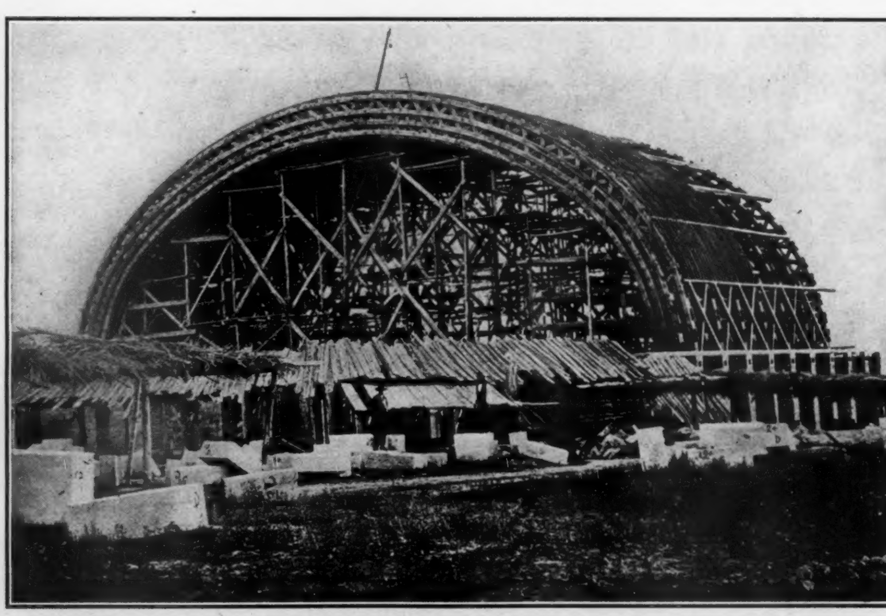
for going west—that of founding a new Jerusalem. Mormon historians relate that on the afternoon of July 27, 1847, President Brigham Young, accompanied by his apostles, walked out to a spot between the forks of City Creek and, striking the earth with his cane, said: "Here will be the Temple of our God. Here are the forty acres for the Temple. The city shall be laid out perfectly square, north and south, east and west."



Electrically driven blowers that furnish 8,500 cubic feet of air a minute at pressures ranging from 5 to 15 inches.

The architectural ingenuity displayed by the early Mormons in building the Tabernacle that houses the great organ deserves more than passing notice. The first places of worship, consisting of shelters of poles and hides and brush, were called boweries. As soon as wood and stone could be cut in the nearby mountains, more substantial structures were erected. The present Tabernacle was not started until 1863. In designating to his architects, William H. Folsom and Henry Grow, where the Tabernacle should be built in Temple Square—now a beautifully wooded and landscaped park in the heart of the city, Brigham Young is supposed to have opened his umbrella and said, pointing to its oval shelter: "The Tabernacle ought to be shaped like this." And, in accordance with his commands, "Out of the desert a Tabernacle arose."

Mr. Grow had built, in Pennsylvania, many bridges of the Remington lattice type. This style of construction recommended itself highly to the pioneers, as pegs instead of nails were used to hold the structure together. At that time it was difficult to secure iron; and nails had to be hauled hundreds of miles across the plains by ox teams. So it happened that the roof of the building—which is 250 feet long, 150 feet wide, and 80 feet high, and covers an auditorium capable of seating from 6,000 to 8,000 people—was reared without nails or spikes.



Mormon Tabernacle as it looked when under construction 60 years ago. Neither nails nor spikes were used in building the wooden roof.

The huge roof is self-supporting. The wooden arches, spanning 150 feet, are of lattice-truss construction and are held together with wooden pegs and are bound with cowhide. The roof rests upon buttresses of red sandstone, placed at intervals of 10 and 12 feet. The pegs were so driven that pressure only increased the strength of the union of the various timbers composing this vast domelike inclosure.

With the edifice nearing completion, Brigham Young realized that impressive music would be needed to fill its ample spaces and to "sing the Gospel into the hearts of the people." Accordingly, the venerable leader of the Saints directed that an organ worthy of the Tabernacle should be constructed. This project, perhaps as well as any conceived by him, illustrates the daring of the man's conception and the power to achieve his dreams. Fortunately, there resided in the community of Latter Day Saints one Joseph Ridges, who had gone from England to Australia where he had learned the organ-building trade. In 1856, when converted to Mormonism, he journeyed from Australia to Utah.

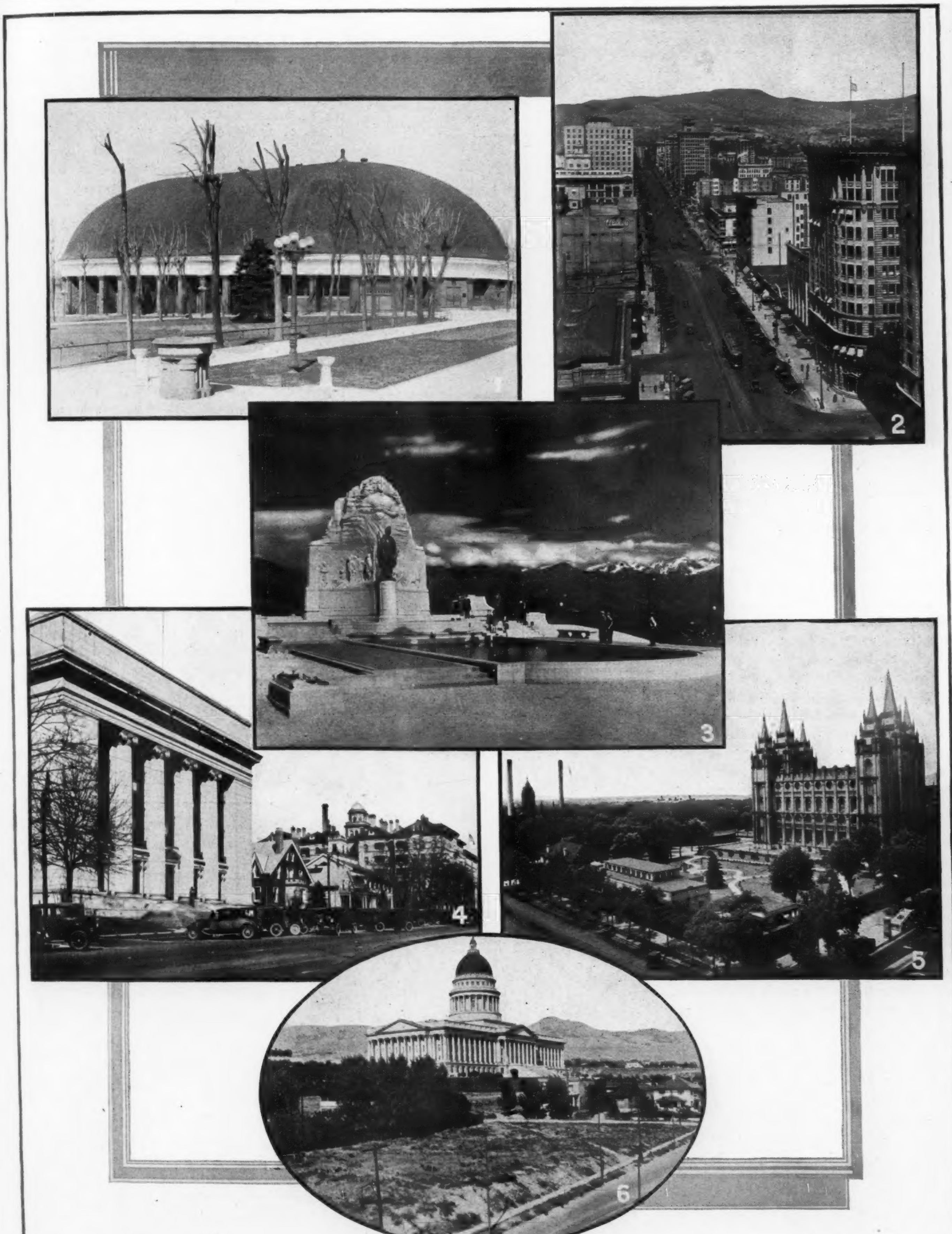
Although the building of such an instrument was a tremendous undertaking for a pioneer community, still the Saints—under the inspiring leadership of Brigham Young—attacked the problem with a thoroughness and an enthusiasm that assured success. Mountains were ranged to find suitable timber; tools fashioned; hides collected; and glue was made. In the Hills of Parowan was discovered a variety of white pine, free of knots and with little resin. This, it was decided, was best suited for the structure of the organ. The large pipes—some measuring 32 feet in length and requiring thousands of feet of timber—had to be hauled 300 miles to Salt Lake. Over the lonely, dusty roads the oxen trudged for weeks and months. As many as 60 yoke were needed at a time. For a period of one year and ten months, until the organ was completed and dedicated in October of 1867, one hundred men were continually employed in its construction.

The first equipment used to furnish the air pressure required for the operation of the organ was not only crude but laborious to handle. Six men pumped feeders which forced air into chests. Later, an ingeniously contrived water motor drove the feeders. This equipment was supplanted by electric motors. Today, two 15-hp. rotary fans—driven at a speed of 800 revolutions per minute and, combined, capable of supplying 8,500 cubic feet of 5-inch air a minute—furnish the great volume of air needed to play the organ.

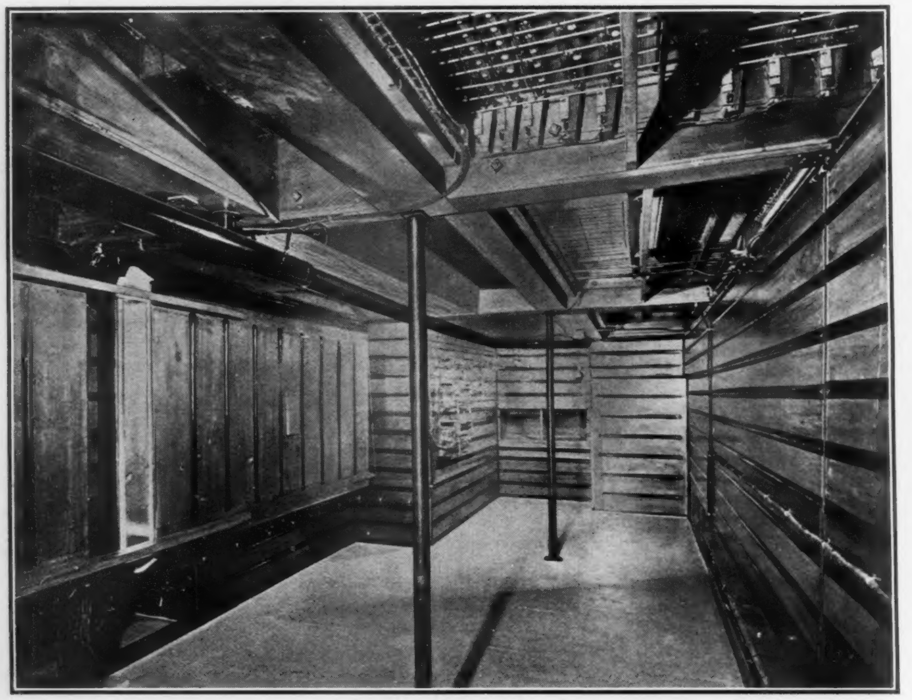
These fans force air at 5-, 10-, or 15-inch pressure into the various air chests—some of which are as large as an ordinary room. In each of these chests, one wall—which measures the length of the chamber—is made to act as an equalizer, that is, it is backed with hundreds of steel springs so that the expansion and contraction of the air column is automatic. During playing, the position of the equalizers changes continually in accordance with the demands of the instrument for air—thus insuring a uniform pressure. When a passage is played that needs much air, the walls press inward and contract the free space in the different chests. This action opens a damper controlling the volume of air supplied by the blowers, and more air is forced into the chests. When less air is required, the equalizing walls retreat and so increase the air space and cause the damper to close.

The Mormon organ—representing an investment of at least $100,000 — is so constructed that any one of the air chambers can be entered while the organ is being played for the purpose of making adjustments. This is a consideration of the utmost importance in the case of an instrument of the splendid proportions of the Tabernacle organ, that must be frequently inspected if the instrument is to be kept at its highest efficiency for the daily recitals. A series of doors, contrived to keep the air pressure uniform within the chambers, permits access to the lungs of the organ.

Over the air chests are placed myriads of



1—Tabernacle in which is housed the great organ. This building can seat 8,000 persons.
2—Salt Lake City looking north on Main Street. The city was founded by Brigham Young in 1847.
3—Monument recently dedicated to the Mormon Battalion that marched to the Pacific coast to support the United States Government during the Mexican War. Wasatch Mountains in the background.
4—Office building of the Church of Latter Day Saints.
5—Temple Square containing the Temple, the Tabernacle, the Assembly Hall, and the Museum.
6—State Capitol situated on a hill that dominates Salt Lake City.



Air chest of the great organ, showing the equalizers and the valves for controlling the organ pipes.

pipes varying in length from ⅝ inch to 32 feet. The opening of the valves, that are controlled by the organist at his keyboard, allows air to enter the pipes and causes them to give forth their respective notes. Tonal quality is determined by the form and the size of a pipe; by the kind of wood or metal of which it is made; and by the shape of the mouth through which the air is forced.

The organ is actuated throughout by electricity; and nearly 2,000 magnets are used in controlling the mechanisms. The number of pipes is in excess of 8,000. These pipes are divided into seven sections: great organ, swell, orchestral, solo, celestial, string, and pedal. The console or keyboard is relatively compact when compared with the mammoth instrument. In addition to its four banks of manual keys and pedals, the keyboard has no fewer than 270 appurtenances that the organist must keep in mind.

The variety of tone that can be secured from the mere passage of wind through different-sized and different-shaped pipes is bewildering. For example, ethereal harp music, closely resembling the sound of that well-known instrument, is made by the passage of air through pipes that releases hammers. These hammers strike on metal disks which send vibrations through the resonating spaces of the pipes and induce harplike tones.

The echo or celestial organ is situated in a brick-and-concrete chamber, under the floor of the east end of the Tabernacle, more than 200 feet from the organ. It can be played from either the great or solo manuals, or from both—duplex action and stops being provided so that it is really a 2-manual-and-pedal organ. Vibrations are transmitted from this chamber upward through the floor into the east wall of the Tabernacle by way of passages resembling ventilators.

RIVETING MORE ECONOMICAL THAN WELDING?

The following letter from the Hanna Engineering Works, Chicago, Ill., on welding as against riveting, is published in full for the benefit of those of our readers who are interested in this subject:

"COMPRESSED AIR MAGAZINE,
11 Broadway,
New York, N. Y.
DEAR SIR:

After making due allowance for items included in this first job, which would disappear if the shop were organized for welding, the all-welded 5-story shop building, erected at Sharon, Pa., by the American Bridge Company for the Westinghouse Electric & Manufacturing Company, cost $5,800 in excess of what a riveted structure would have cost. Prevailing overhead expenses are included in this comparison.

Welding in the shop cost four times that of shop riveting. Welding in the field cost about the same as field riveting.

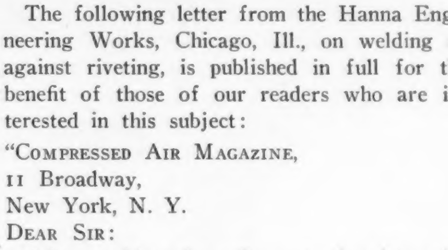
The value of the equipment used for field welding is estimated at about $16,000. The equipment for field riveting would only have been about $5,000 or $6,000.

The welded design saved 95 tons of steel; the cost of templates was a trifle less than for riveting; and shearing, marking, punching, and finishing about 10 per cent. less than for riveting. But the assembling of members for welding cost 100 per cent. more than for riveting; and the field-erection cost, due to extra guying for alignment, was 10 per cent. more than for the riveted structure.

These are facts disclosed in an address, *Commercial Application of Welding to a Steel Structure*, by Mr. James H. Edwards, American Bridge Company, before the American Iron & Steel Institute, May 20, 1927. We quote from Mr. Edwards' address as it appears in the *Iron Trade Review* and *The Iron Age* of May 26, 1927:

'Based on the experience gained from this work it would seem that the all-welded skeleton structure is not the most economic one. . . . . Designers and fabricators of structural steel from many years of experience have learned the virtues and weaknesses of rivets and know how to use them to make safe and economical structures.'

Very truly yours,
HANNA ENGINEERING WORKS,
A. F. Jensen, President."



© Keystone View Company, Inc.
Making up with compressed air at Hollywood.

WHALE INTERRUPTS CABLE SERVICE

THE following news item, while it may sound like a whale of a story, is a true whale story, as the United States Navy Department stands sponsor for it. According to advices to that Government department:

"On April 3, word was received by radio at Seattle, Wash., that the cable between Seattle and Ketchikan, Alaska, was interrupted. The Army cableship *Dellwood* proceeded to the indicated break. After considerable cable had been pulled up, a whale was brought to the surface helplessly entangled.

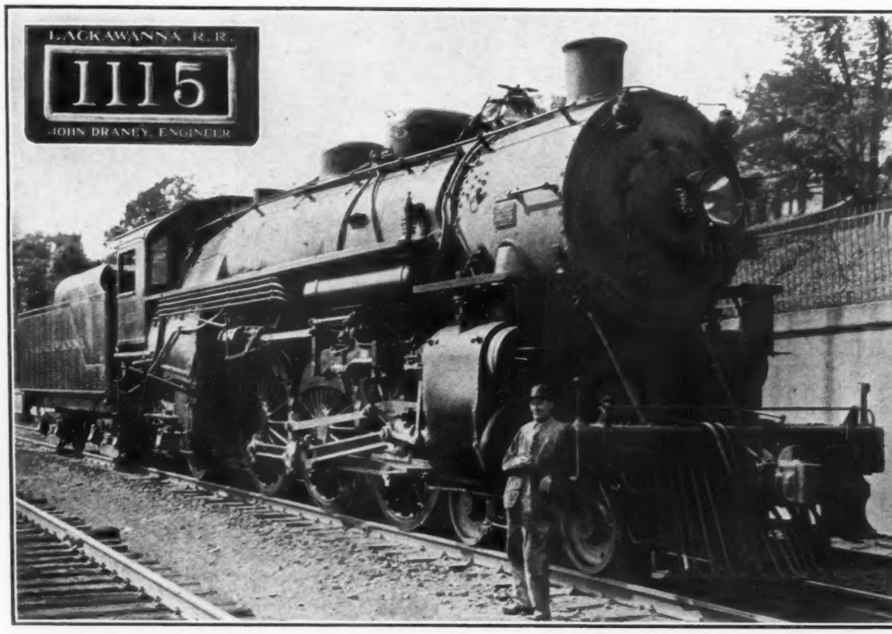
"The core of the cable had been completely severed by the teeth of the whale in eight different places and about 80 feet had to be replaced. Inasmuch as the cable core is covered both by gutta-percha and heavy iron armor, and is very difficult to sever even with machinery, some idea of the whale's biting strength may be obtained."

Over 95 per cent. of the automobiles used throughout the world are of American make, according to the world census of motor vehicles just compiled by the Bureau of Foreign and Domestic Commerce.

At the Throttle of a Lackawanna Limited

By ALLEN S. PARK

FOR 54 years John Draney has been a railroadman. For 38 of those years he has been a locomotive engineer. All his service has been with the Delaware, Lackawanna & Western Railroad. At the present time he runs a local train out of Hoboken, N. J., to Scranton, Pa., in the morning. That afternoon he "pulls" the Lackawanna Limited back to Hoboken, completing the final leg of that special train's trip from Buffalo.



The veteran engineer and the "iron horse" that he drove for a number of years. Insert—When John Draney rounded out 50 years of service with the Lackawanna, the road presented him with a replica of the number plate of his engine.

Mr. Draney, or "Jack" Draney—as he calls himself, and as he is also called by the hundreds of friends he has made during his long period of railroading — looks and feels fit for many more years of active duty. Though he will soon be eligible for retirement, those who know him best say that the Lackawanna will have to place all its locomotives under lock and key to keep him out of a cab. The veteran engineer hints at the same thing when he says of himself: "I may wear out, but I'll never rust out!"

Possessed of unusual vigor of mind and body, and a pronounced interest in the human element of railroading as well as in its mechanical phases, he has been prominent for many years in various movements among railroad employees to better their status and to improve the service that they render to the traveling public. He is serving his eighth consecutive year as president of the Lackawanna Veterans Association. He has frequently come into touch with high officials of his own and of other roads; and they have grown to look upon him as one whose words are always well worth hearing. There are few closed doors to "Jack" Draney in the railroad industry.

"Jack" Draney started railroading on May 1, 1873. As a boy—and he must have been a very small one at that—he began as a water carrier on the Paterson, N. J., division. His pay was 50 cents a day. When he had grown sufficiently to stand harder work, he became a track laborer. For this service he received 90 cents a day. A little later on he became a car oiler in the shop pits. His superior was James Neafie, father of A. J. Neafie who is at the present time principal assistant engineer of the Lackawanna.

His next job was that of brakeman on a work train. A while later he served as a steam-shovel engineer, in which capacity he took part in the extension of the Lackawanna line to Buffalo during 1880 and 1881. Meanwhile, he had some experience from time to time in firing locomotives; and, upon his return to Hoboken, he was transferred to that work. In 1886 he became a roundhouse foreman, and on July 21, 1889, he was made an engineer. He was on a night run for a number of years, and was assigned to his present schedule in 1914.

In 1901, when President McKinley was shot by an assassin, Mr. Draney was selected to run the special train to Buffalo that carried Doctor Janeway of New York City to the dying president's bedside. The road was cleared; and he mounted to the cab with the single order to stop only for water. His running time for the 410 miles has never been equaled, or even closely approached. Before the train had gone 50 miles, Doctor Janeway sent a trainman forward to the engine requesting Draney to slow down. He complained that he was unable to keep his seat. All the satisfaction he got from "Jack" Draney was the terse return message: "Lie down in the aisle: my orders are to get there as soon as possible."

Although he has piloted passenger trains many thousands of miles, Mr. Draney has never had a wreck. He declares, however, that he has been in situations "where space was worth a good many dollars an inch." It is only natural

**Left—Hand tamping cinder ballast by the old method.
Right—Tamping rock ballast by the new method, using air-driven tie tampers for the purpose.**

that during his memorable career at the throttle, Mr. Draney should have become more or less of an authority on certain phases of the railroad industry. He has lived through many important changes and developments in rail transportation.

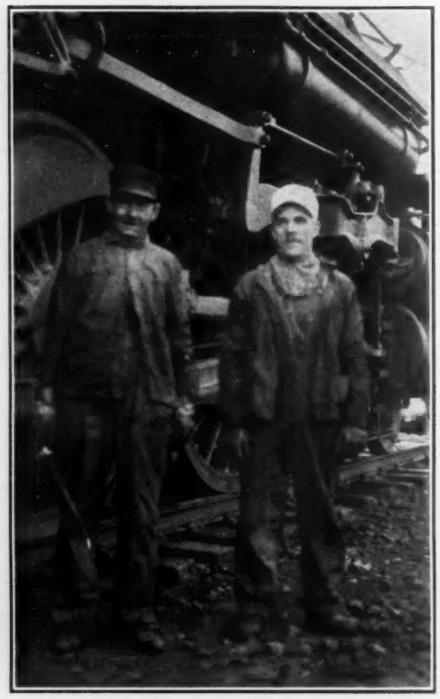
Comparatively few people have had the opportunity to ride in the cab of a passenger engine drawing an express train. The average person can therefore not fully appreciate the totally different sensation that is received there from that felt when riding upon upholstered car seats. There is, in fact, a marked difference. Because of the height of the cab above the tracks, every side-to-side movement is intensified, and even minor irregularities in the track cause the superstructure to lurch considerably. This "rolling" of a locomotive can be noted if one views its onrushing approach close at hand.

While a locomotive has springs, they are of a different type from car springs, and do not function with the same degree of delicacy. The result is that shocks imparted by the drive wheels to the rails are very perceptibly transferred through the frame to the cab rider. Every jolt and jar is felt in accentuated form. Instead of the familiar, rhythmical clicking sound that marks the passage of passenger cars over rail joints, the cab rider finds his ears greeted by a noise more akin to booming.

In the more than half a century of railroading in which Mr. Draney has witnessed continual improvements in track building, his lofty seat has proved a vantage point well suited for noting the effect of those improvements on the ease with which trains pass over the rails. This effect, he declares, has been very decided. The modern roadbed is much more conducive to easy riding than was its earlier counterpart.

One phase of the matter that may be cited by way of illustration is that of tie tamping. The present-day roadbed, with pneumatically tamped ties, is so superior to the old roadbed with hand-tamped ties that Mr. Draney finds he is able immediately to distinguish between the two by riding over them. "I can tell when I pass from the old type to the new type," he explains, "because there is far less spring to a track which rests on ties that have been pneumatically tamped. There are also fewer irregularities in the track, and this more even running surface reduces the vibration of the engine as it travels at high speed."

In an earlier era of railroading, which Mr. Draney remembers vividly, engines and trains were lighter than they now are and there was not so much need for care in constructing and in maintaining the track. The Hoboken-Buffalo line of the Lackawanna, for example, was ballasted with the same sort of material that bordered the tracks, or with something very similar to it. Rails weighed 80 pounds to the yard, and were laid directly upon the ties, to which they were fastened by ordinary spikes. Rail laying was laborious work, done largely by hand. Ties were tamped by man power. Today, the same link of the system is entirely rock ballasted. Rails weigh 135 pounds to the yard, and come from the steel mills in lengths of 39 feet instead of 33 feet.



"Jack" Draney and his fireman, I. R. Burriss, who "keeps her hot" for him.

Mr. Draney in distinguished company on the White House lawn. This view was taken when a group of railroadmen called to pay their respects to President and Mrs. Coolidge.

Pneumatic tie tampers, driven with compressed air from portable compressors, tamp the ballast firmly and evenly beneath each tie in a fraction of the time required when the work was done by hand and nothing like so well. Track-laying cranes handle the rails during construction. The rails are laid on iron plates and are doubly moored by use of both screw spikes and cut spikes.

Once laid, track must be continually maintained, and this calls for the periodical replacement of ties. Each time this is done, careful readjustment of the rails must be made lest the running surface be rendered uneven. Here, again, pneumatic tie tampers operate with an efficiency that cannot be matched by hand methods. The reason is that the air-driven tamper delivers an even blow of uniform force, hour in and hour out. Men tire, but the pneumatic machine never does. Furthermore, the mechanical tamper works for less than the manual tamper. Four men with pneumatic tampers will do as much work as 12 to 16 men with picks and bars—and will do it better.

In the light of these facts, it is entirely understandable that a man of Mr. Draney's long experience at the throttle can instantly discern the passing of his engine from a hand-tamped to a pneumatically tamped roadbed.

SWEDEN PROMOTING ITS IRON INDUSTRY

THE Swedish Minister of Commerce, in a recent interview, is reported to have stated that his government is preparing measures looking towards the support of the country's iron industry. Work in this direction was begun last year when the Swedish ironworks formed an organization to promote their cause. This organization is now planning to widen the scope of its activities by appointing a common technical council and four committees whose task it will be to study different problems connected with the making of iron and steel.

A large sum of money is being made available for scientific research; and this is being raised in an unusual manner. With one exception, all the ironworks have declared themselves willing to contribute to the fund by paying 20 öre, about 5 cents, for every ton of ingots and blooms produced by them and 10 öre for every ton of pig iron exported.

Harnessing the Gatineau River

Description of the Great Newsprint Mill That Will Be Operated With Power From This Source

PART III

By R. C. ROWE

THE Gatineau plant of the Canadian International Paper Company is being constructed to give an initial output of 600 tons of newsprint a day; but this output can be increased should future demands warrant it, as the plant has been designed with that object in view.

There are two independent slasher and barking mills on the banks of the Ottawa. Each unit, consisting of a slasher mill and a battery of Paulson barking drums, has a capacity of 32,000 logs per day. From the slasher plants, the blocks are conveyed automatically to the barking drums. These machines consist of large revolving cylinders of open steelwork construction. The blocks are fed in at one end and travel by gravity to the discharge end—the bark being removed by friction and by the tumbling action of the blocks against one another. Heavy streams of water, played on the drums, assist in the barking process and carry away the loose bark. There are two batteries of these machines, each consisting of three drums. They were built and installed by the Canadian Ingersoll-Rand Company, Ltd., and are 45 feet long by 15 feet in diameter. Each drum has a capacity of more than 300 cords a day.

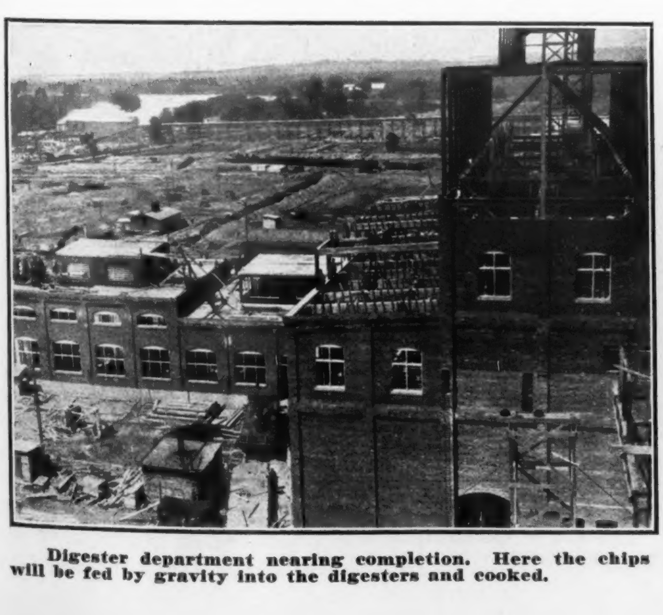
Chipping mill where the logs of spruce are made ready for the sulphite digesters.

The barked blocks are carried to storage piles; and, literally, there are hills of these blocks covering a large area. A very intricate and highly efficient system of high-pressure water nozzles is installed around these storage piles to protect them against fire. A water-purification plant, together with a steam plant burning wood refuse, is located on the river-front. The chipping plant is located near the storage piles. There a proportion of the pulpwood blocks are converted into chips preparatory to their manufacture into sulphite pulp. The chipping machines are made up of a series of heavy knives revolving at high speed.

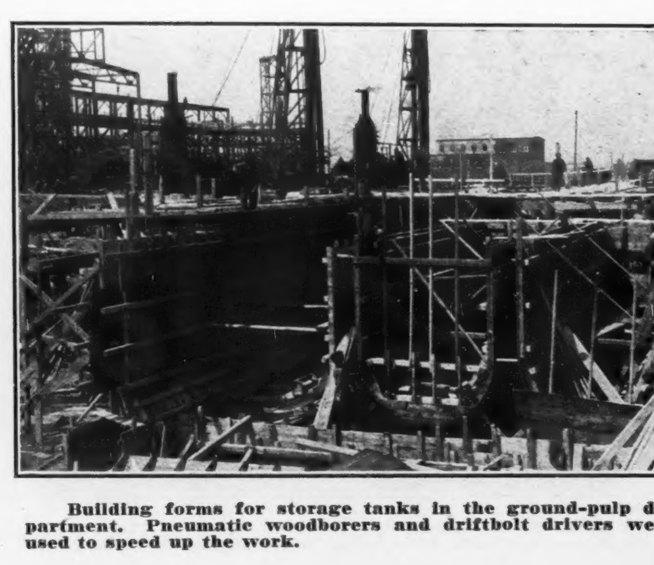
From this point onward, all the operations are carried on under one roof—the different departments being housed in one building that covers an area of six acres. This structure is of steel and brick—all exposed steel being covered with gunite shot in place with compressed air. The nuclei of the main building are two paper mills. These two departments are separated by a considerable distance, and between them are placed a secondary transformer plant, a wrapping-paper mill, and machine and carpenter shops. Adjacent and to the west of the paper mills are the sulphite- and the ground-wood-pulp plants, and to the east are the paper-storage and loading plants.

The sulphite plant contains several departments, the first being the sulphur-burning room in which are three Waterous burners. An interesting adjunct to this department is the provision made for sulphur storage, a circular tank capable of holding 60 carloads. The sulphur fumes from the burners are cooled in special apparatus and piped to acid towers, which are a necessary feature of the sulphite process of making pulp. The acid towers, two in number, are slender, symmetrical structures 100 feet high. Placed between them is a third tower, which houses a freight elevator used for charging.

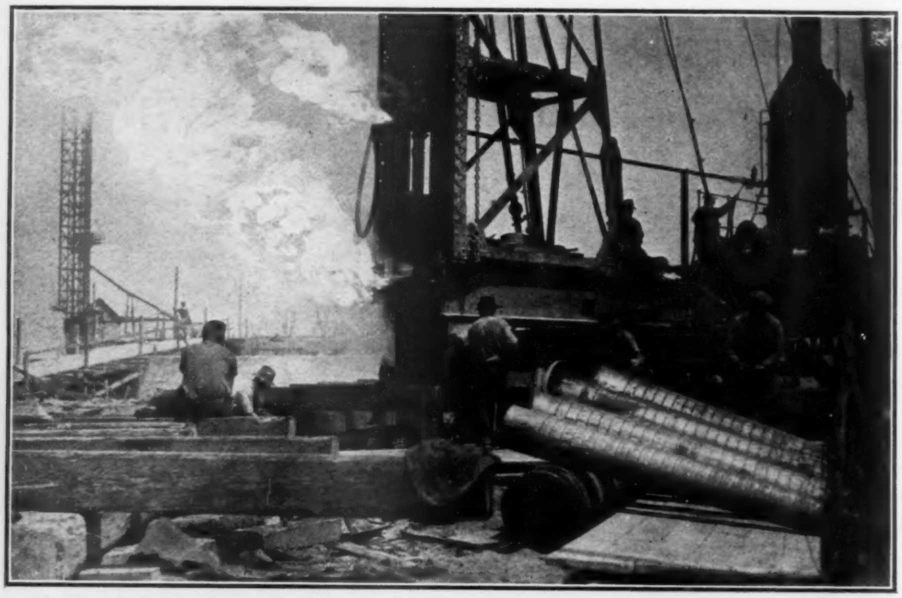
When in operation, these towers will be filled with crushed limestone. Specially arranged sprays, at the top, distribute cold water so that it descends through the limestone in thin streams. The sulphur fumes—sulphur-dioxide gas—are introduced at the bottom of the towers, and they ascend through the cracks and interstices in the limestone mass. In their



Digester department nearing completion. Here the chips will be fed by gravity into the digesters and cooked.

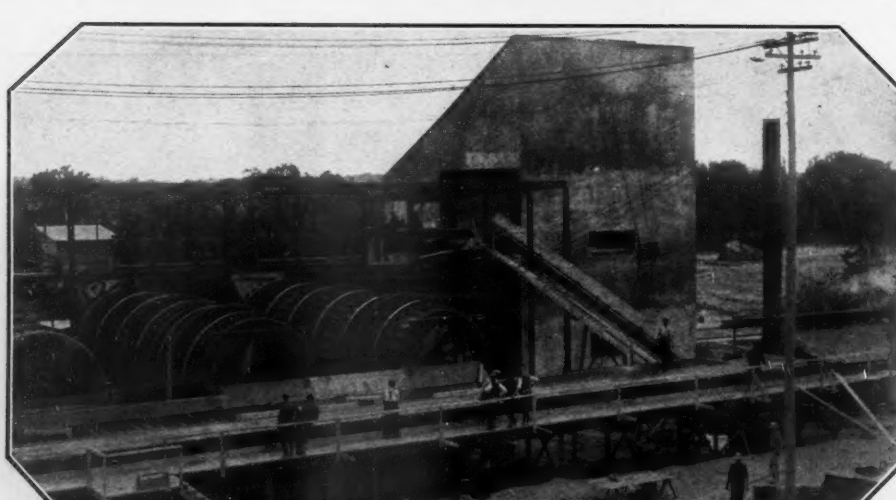


Building forms for storage tanks in the ground-pulp department. Pneumatic woodborers and driftbolt drivers were used to speed up the work.



Driving hollow piles, preparatory to filling them with concrete, on the site of the electric boilerhouse.

Air-driven jam riveter at work on a barking drum at the Gatineau Mill.



Three of the big Paulson barking drums at the Gatineau Mill. The battery of six drums can bark 1,800 cords in the course of a day.

ascent they are rapidly absorbed by the downcoming water, forming sulphurous acid which, in its turn, attacks the limestone and forms bisulphite of lime. This product is drawn off at the bottom of the towers, and is cooled in special apparatus mainly characterized by the fact that they contain 7 tons of lead pipe each. The resulting liquid is stored in six cylindrical wooden tanks each having a capacity of more than 35,000 gallons.

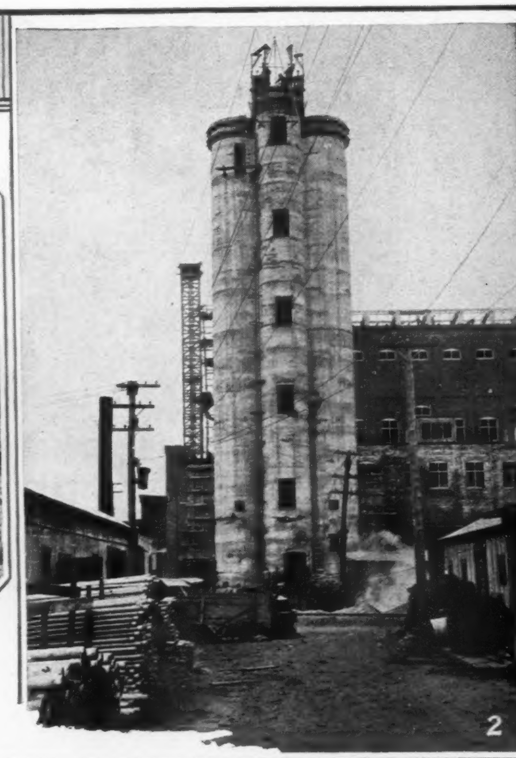
This brings us to the digester plant. This is equipped with huge bins in which are stored the chips produced by the chipping mill. The bins discharge into six digesters, massive steel machines designed to withstand a water test of 120 pounds to the square inch. The digesters are lined with acid-proof brick superimposed on asbestos and cemented with a special mortar made up of quartz sand, litharge, glycerine, and silicate of soda. Fortunately, these machines do not have to be lined often.

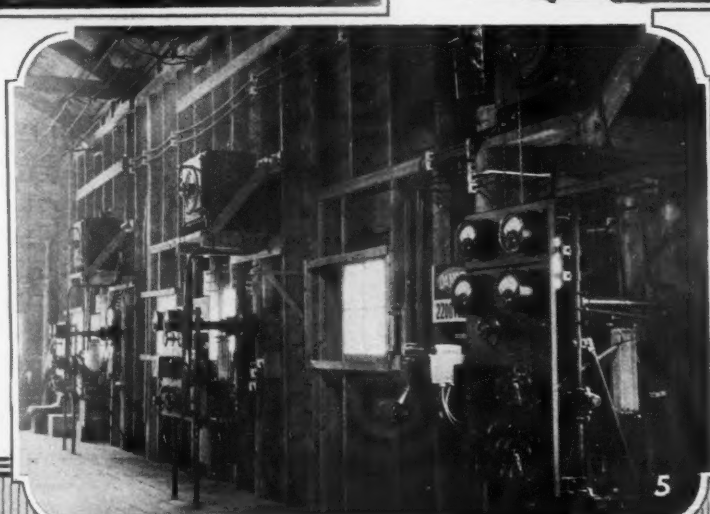
The process that goes on inside the digesters is just about what the name suggests. They are, in fact, mechanical stomachs using bisulphite of lime instead of gastric juices. In practice, they are filled with a mixture of wood chips and bisulphite of lime. After the digesters are closed, the mixture is boiled by steam for several hours under a pressure of from 65 to 85 pounds. This operation breaks down and dissolves the gummy and resinous intercellular structure of the wood, thus liberating the cellulose.

When this stage has been reached, the steam pressure is lowered to about 30 pounds; a valve is opened; and the digested stock is blown into "blow pits." These pits have perforated bottoms through which the liquids settle, while the fumes are carried off by "vomit stacks" rising to a height of 100 feet and more. The blow pits, themselves, are of special construction. They are built of concrete and lined with British Columbia fir timbers which are, in their turn, sheathed with 3-inch planking. No metal can be used: all joints are made with oak pins.

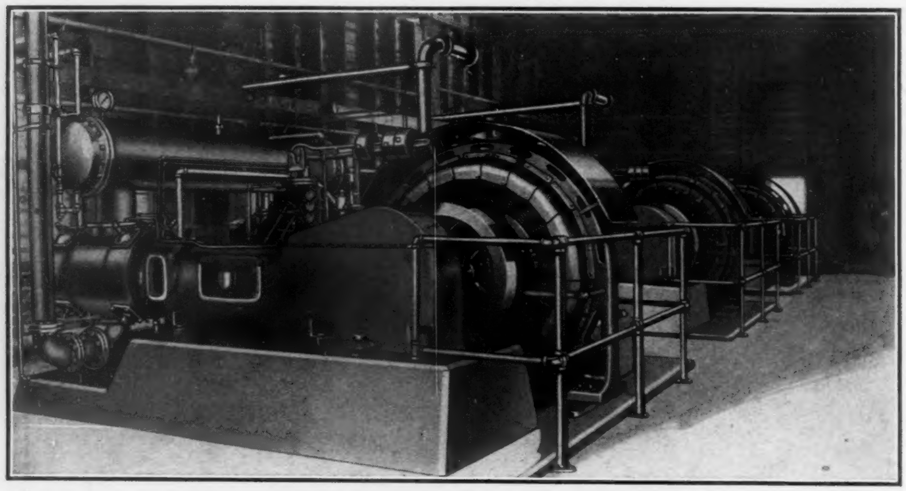
The sulphite stock is pumped from the blow pits into a system of storage tanks, whence it passes on to screens that remove undigested knots, etc. Finally the stock goes to the mixing department, where it is mixed with the ground wood pulp, fillers, etc., before being conveyed to the paper mills. Only about 25 per cent. of the pulp used in the manufacture of newsprint is of the sulphite variety. The other 75 per cent. is ground wood pulp.

The process of manufacturing ground pulp is purely mechanical, and therefore much simpler than that of making sulphite pulp. Broadly, it consists of grinding the wood blocks to pulp by means of huge grindstones weighing about 7 tons each. It has an advantage over other pulp-making processes in that it yields more pulp per cord of wood used. In short, in the case of mechanical grinding, more than 1,900 pounds of pulp is obtained per cord of wood, while the yield in the case of the sulphite process is around 1,000 pounds per cord. There are 24 grinders in the Gatineau plant and they require 24,000 hp. to drive them. Huge storage tanks are a feature of the





1—Accumulating piles of barked pulpwood.
2—Acid towers nearing completion at the Gatineau Mill.
3—Fire-protection water tower in course of erection. Pneumatic tools have been used on this work.
4—Part of the construction camp at the Gatineau Mill.
5—Control panels installed in the compressor room at the Gatineau Mill.



The three large PRE-2 compressors that furnish compressed air for numerous purposes in the Gatineau Paper Mill.

ground-wood-pulp plant; and the stock goes through various screening processes before it finally combines with the sulphite pulp in the mixing department preparatory to being converted into paper.

Some idea can be had of the immense quantities of liquids handled in modern paper mills when it is understood that some 70-odd pumps are required in the plant in question to take care of the ground-wood and sulphite stock, acid liquor, raw water, filtered water, etc. The pumping plant has a total capacity of approximately 400,000,000 gallons a day—the filtration plant, alone, handling about 90,000,000 gallons of water daily. All these pumps are of the Cameron type. Multi-stage pumps of this type are also used for the governor-control mechanism in the powerhouses at Chelsea and Farmers Rapids.

The two newsprint mills are the nerve centers of the entire works—all the other varied operations are tributary to them. They are huge, lofty, and well-lighted buildings; and each will house two paper machines, making a present installation of four units. These machines, which are said to be the largest in the world, were made by the Dominion Engineering Company. Each will turn out paper 256 inches wide at the rate of 1,200 feet per minute. At this rate, the four machines will reel off in excess of 1,300 miles of paper, weighing around 600 tons, every 24 hours.

Such figures as these, even in an age of colossal production, cause one to pause and to ponder what tomorrow may bring forth. One tries to imagine a strip of paper 21 feet wide and 1,300 miles long, but the mind simply cannot picture it. We quote these figures glibly, with satisfaction; and we point to the fact that it is not so long ago, comparatively speaking, since man made all paper by hand. The first paper machine was produced about 120 years ago. Yet, in an account of papermaking in 1886, we find the following statement regarding the paper machines of that day: "It has been computed that an ordinary machine, making webs of paper 54 inches wide, will turn out 4 miles a day." Here we have the same pride in mechanical accomplishment. We make this comparison not to show that human nature is unchangeable, but to point out the utter futility of attempting to foretell by the progress of today what will happen in the future.

Adjoining the paper mills, there is a 3-story paper-storage building capable of accommodating thousands of tons of paper. Abutting this, is the loading department, with every modern facility for handling and shipping the great rolls of newsprint.

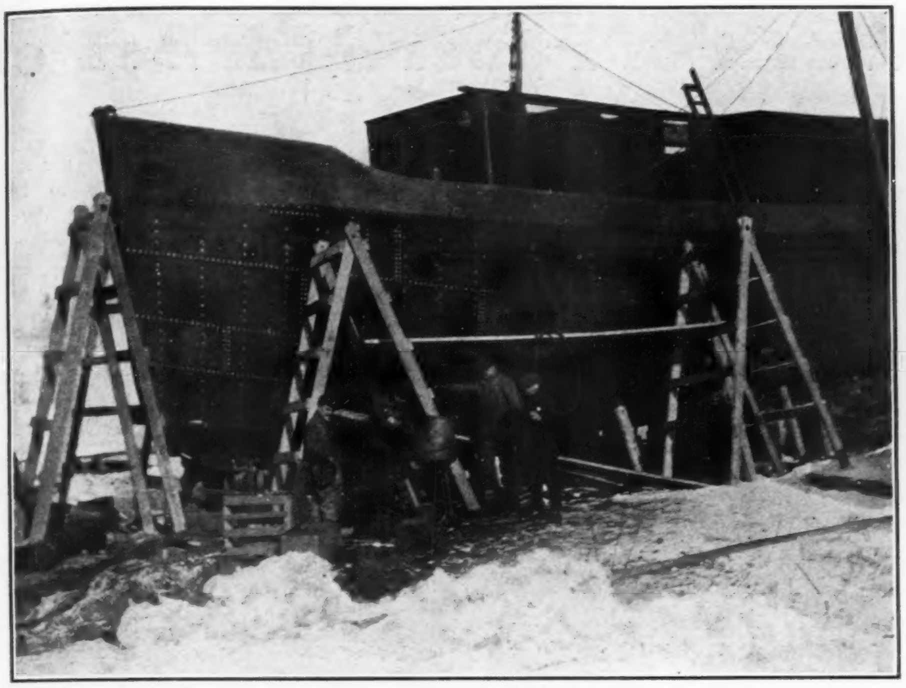
The entire works will be electrically driven, and the mechanical requirements will be in excess of 35,000 hp. Electrically heated boilers will supply the enormous quantities of steam needed in the manufacture of the paper. But it is likely that, as the excess power is taken off the Gatineau and used for industrial purposes, the present electric boiler plant will be gradually superseded by fuel-fired boilers. Power will be transmitted to the works at 110,000 volts and handled by two transformer houses. All transmission lines from the main transformer house, where the overhead wires enter, will be underground.

Obviously, in operations of this magnitude, compressed air plays a big *rôle*. Apart from such work as drilling, it is used for driving piles, for riveting, for shooting gunite, etc. As an example of its adaptability, we might mention the case of the man who burned the holes in the bottoms of the blow pits. As has already been stated, the bottoms of the blow pits are of wood. After the necessary perforations are made in the ordinary way, the holes are burned with a red-hot iron. In itself, this is a simple operation; but, just the same, complications developed in connection with it. It was found that the wood smoke was very irritating to the workman's eyes. Something had to be done about it. Compressed air proved to be the remedy; and a neat arrangement was devised that caused a gentle draft of air to carry away the smoke before it had a chance to reach the operator's eyes. Compressed air is supplied from a central compressor plant, equipped with three Class PRE-2, electrically driven, 2-stage machines, whence it is piped to every part of the works. This compressor plant is provided with Midwest air filters which keep out harmful dust.

No small item concerning all the construction jobs—the paper works as well as the hydro-electric developments—is that of housing, provisioning, and handling the large force of men employed. Long experience, however, has enabled the Frazer-Brace Engineering Company to so systematize this essential department that operations can proceed under the best of working conditions. Comfortable sleeping camps are erected; and some of the messhalls are capable of accommodating 500 men at one sitting. Rigid discipline is in effect at the camps—a special police force being maintained to keep order and to enforce camp regulations.

After having traveled over the entire system from far up the Gatineau River where the spruce grows thick to the great works where that spruce is eventually turned into paper; and after having seen the great storage system at Bitobee, the Gatineau harnessed by three

Driving sheet piling at the Gatineau Mill with a CC-35 pneumatic pile hammer.



One of the three tugs, 75 feet long, built for use in connection with the Gatineau Power Development. The hulls were constructed in Toronto; knocked down and shipped by rail to the station nearest the development; and then hauled overland for 35 miles, by sleigh and tractor, to the point where they were reassembled.

superpower plants, and the transmission towers stretching their ways to Toronto, Gatineau, and Hawkesbury, then one is overcome by a feeling of wonderment that so much can be accomplished by one organization.

The men who planned all this and are carrying it through to fruition, and those who are laboring with their heads and their hands, are leaving something that posterity can judge us by—something that epitomizes the age we live in and that will show what manner of people we were. We know that what they have done is done well, and that the story they have written into the ponderous structures of steel and concrete is a romance of achievement characteristic of the engineering world of today.

PNEUMATIC PIG BREAKER AN INNOVATION

MACHINE instead of handwork is the cry in industry today, especially in the United States where a large volume of output is counted upon to reduce operating costs in order to offset the comparatively high wages paid American labor. Anything, therefore, that will speed up performance and lower the cost of production is apt to find ready application provided, of course, the thing is practicable.

An interesting example of this kind is that offered by the Sloss-Sheffield Steel & Iron Company, of Birmingham, Ala., in whose blast-furnace department great savings in labor are being effected as a result of the substitution of pneumatic equipment for hand labor in breaking up pig iron. The system, as developed in their plants, includes the use of a Dovel pig breaker, a cast-iron breaking frame, two traveling cranes, and a small air compressor. This machine is of sufficient capacity to furnish about 65 cubic feet of free air per minute—a pressure of from 60 to 80 pounds being used to operate the hammer. Best results are obtained by delivering the air to a small receiver placed close to the pig breaker and by providing the line leading from this receiver to the hammer with a regulating valve. In this way the hammer operator can easily control the air feed to suit the needs of the class of iron to be broken.

In the plant in question, the sow or runner feeds 20 pigs—each comb weighing 2 tons. This load is hoisted bodily from the sand bed by one of the traveling cranes and deposited upon the raised breaker platform. This platform consists of a heavy cast-iron frame or grating through which the pieces can drop into railroad cars standing beneath. With the comb in position, the Dovel pig breaker—which is flexibly suspended from the second crane—is spotted over the mass to be shattered.

The hammer is of sturdy construction and can, so it is said, break a pig in half and sever it from the sow at one blow. It is also capable of breaking the sow into pieces of convenient length—striking blows at the rate of 50 or more a minute at the will of the operator, who can control the force of the blows by the movement of a hand lever. It is claimed that the machine is so powerful in its action that an entire cast of 43 beds has been shattered in 45 minutes. However, the skill of the crane operator somewhat determines the time in which the cast-iron combs are disposed of, as he must keep the crane—which travels at a speed of 25 feet a minute—going steadily. If a pig is missed, it is broken when the trolley and the hammer are returned for the purpose of breaking the sow.

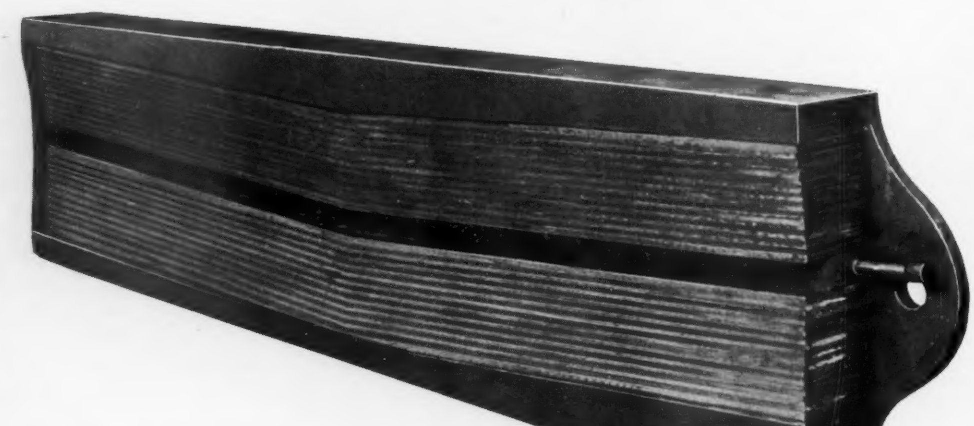
The whole system is so well coördinated that an entire cast can be lifted from the beds, placed on the frame, and be broken up and loaded into railroad cars by 5 men and at the rate of about a ton a minute. This speed of performance is of advantage in another direction: the sand beds can be quickly cleared and prepared for the next cast, thus increasing output. In conclusion, let it be said that the introduction of this labor-saving equipment has made it possible to dispense with the services of 27 men at a single furnace and to employ them elsewhere to advantage.

After pig iron has been cast at a blast furnace, the next problem is to break the pigs loose from the sows. Here we have a flexibly suspended air-driven hammer that is powerful enough to do this work rapidly.

Air Improves Work of Paper-Mill Beater

By A. M. HOFFMANN

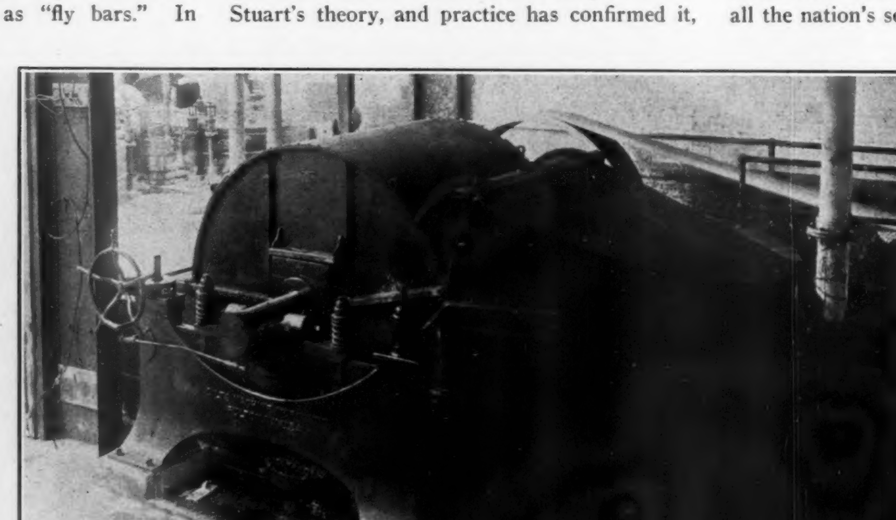
AN interesting application of compressed air in paper mills is in connection with the Stuart pneumatic bedplate for beating engines. This bedplate performs all the functions of the ordinary beater bedplate and embodies several new features that are said to increase the capacity of the beating engine and to improve the quality of the paper stock. It is the invention of David Stuart, of Windsor Mills, Que., Canada, who has had 40 years of experience in the manufacture of paper.



Stuart pneumatic bedplate showing the draft space, between the sets of steel blades, through which compressed air is blown.

To the average man, the process of making paper seems a very complicated one; but, as a matter of fact, it consists of two simple steps. Described in as few words as possible, these are, first, the preparing of the raw material—wood pulp, rags, straw, old paper, and the like—in a beating engine, and, second, the passing of the resulting mass over drying cylinders and between wringer rolls before converting the paper into the sheets of commerce. As everyone familiar with the art knows, "the paper is made in the beaters."

The Stuart pneumatic bedplate is an important part of the beating engine, which is composed of a tank or tub in which a heavy roll rotates. This roll is fitted with steel knives, commonly known as "fly bars." In operation, the tub is filled with water, and into this the wood pulp or other papermaking stock is dumped. The roll is then set revolving in this mass—the knives drawing out the fibers by a sort of brushing movement over the bedplate. The bedplate in question is built up of steel blades set edgewise to the roll and located in the bottom of the tub underneath the roll.



A beating engine in which paper is made. One end of the bedplate is just visible beneath the shaft of the beater roll.

Mr. Stuart's long experience with papermaking has taught him much about the science of preparing stock in the beating engine. He has learned, among other things, that for paper of good quality it is necessary that the fibers be drawn rather than cut or beaten while undergoing treatment in the beater. At this stage of the operations, the vital thing is the contact of the edges of the fly bars with the surface of the bedplate.

Mr. Stuart's pneumatic bedplate, which is patented in the United States and in Canada, provides for a draft space between two sections of the regularly spaced steel blades; and into this space he recommends that compressed air be blown. This would call for no new equipment, as compressed air is now used for one purpose or another in most paper mills. Where this is not the case, a small vertical compressor —such as the I-R Type 15—can be driven from the beater shaft. According to Mr. Stuart's theory, and practice has confirmed it, the draft space causes the stock to travel faster; and, by resorting to compressed air at this stage of the operations, the fibers are crossed and their relative positions disturbed—the stock coming out cool and uniform. To be more explicit, the current of air prevents the pulp from interfering with the free movement of the beater roll over the plate; it assists in the mixing of the mass; and it helps to break up pieces of "broke" or hard bunches of stock without in any way reducing the strength of the fibers.

The pneumatic bedplate, which is manufactured by the Dilts Machine Works, Inc., of Fulton, N. Y., has been in service for months in paper mills in the United States and in Canada; and there seems to be no doubt about it that Mr. Stuart has hit upon a real improvement in preparing stock for papermaking.

INLAND WATERWAYS OF FRANCE

FRANCE is contemplating the canalizing of the River Rhone, now that the Marseille canal to the Rhone is completed. It is recognized that such a step would bring about a big gain in the ocean-going traffic of that port, which now handles approximately one-fifth of all the nation's seaborne commerce.

Inland waterways have played an important part in stimulating trade in France; and long before the coming of the railroad there had been developed in that country a fairly complete system of navigable rivers and canals to relieve the highways and to furnish cheaper transport for coal and other bulk commodities. From 1814 to 1900 France has spent $461,000,000 on the construction and the improvement of her inland watercourses. In 1925 these had an aggregate length of 6,785 miles; and they carried, last year, 38,451,847 long tons of freight.

Underground Blasts Used to Set Petroleum Sands Flowing

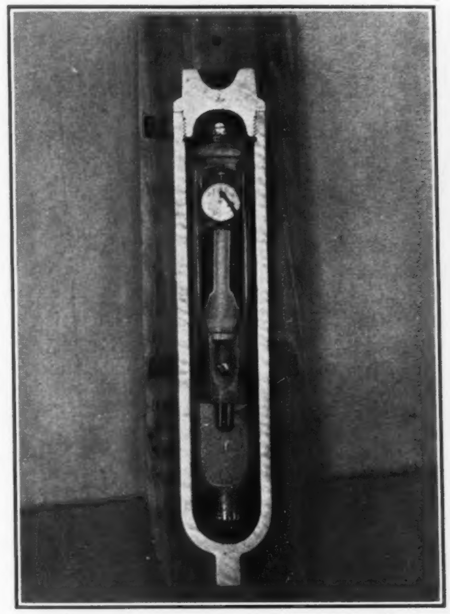
By M. E. CLEMENTS

IN order that the world may have the petroleum necessary to make the wheels of industry turn and the myriads of flivvers and limousines hum over the highways, a considerable number of hardy, daring men spend the major portion of their time in exploding large quantities of nitroglycerin in the depths of narrow holes drilled hundreds, perhaps thousands, of feet into the earth.

The work performed by these professional oil-well shooters is extremely hazardous. The transportation of the sensitive nitroglycerin from the isolated magazine to the oil well; the charging of the shell or torpedo; the lowering of the charge into the well; and, finally, the dropping of the detonator or squib, which lets loose the subterranean inferno, all are calculated to produce a thrill. Sometimes things let go a bit too soon, and then the oil-well shooter ceases to shoot, for a while at least. But, in the main, the shooter carries on. He gets his $10 and more a day, and the world gets its oil.

The general object in shooting an oil well is to loosen the formation—which is generally a hard sandstone and sometimes a limestone—in which the oil is stored, and to create fissures or channels through which the oil may flow into the string of metal casing that constitutes its outlet to the surface of the ground.

In the great Mid-Continent oil fields, as well as in many other oil-producing sections the earth over, it is the custom to shoot a well when the drill has penetrated to the required depth and tapped the particular formation relied upon to produce the stream of "black gold." As the well flows, the heavier hydrocarbons contained in the petroleum tend to clog the channels in the reservoir rock. To reopen them, subsequent shots are detonated from time to time. In some of the Kansas fields, it is not unusual to shoot wells at intervals of every two or three weeks.



Cross section of a time torpedo, used for detonating oil-well blasts, showing the component parts of the mechanism and the cast-iron case in which it is enclosed when lowered into a well.

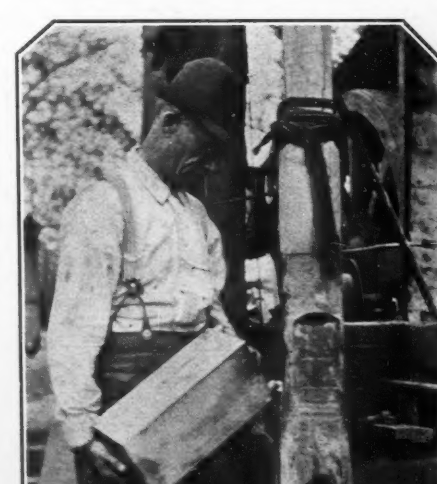
The oil-well shooter employs shells or torpedoes as containers for the nitroglycerin. These are commonly made of tin or of tinned sheet metal; but shells of paper, which has been impregnated with molten sulphur, have recently been introduced in some areas. Being non-metallic, they will not cause sparks through friction with the well casing while being lowered into position for firing.

Where more than one shell is used, connections are made with small tubes of the same material that are known as anchors. The space between succeeding shells may thus be fixed. Sometimes a string of shells will have very short stub anchors between the units, with an anchor on the lowermost member to keep the string at a predetermined distance from the bottom of the hole. When the shells are linked up with longer anchors, then the anchors contain nitroglycerine and are called loaded anchors. The function of the loaded anchor is to span the gap between non-producing strata, so that the main force of the shot can be exerted where it will give the best results.

After the string of nitroglycerin-loaded shells has been lowered to the depth desired, the explosive is fired by one of several methods. The oldest of these is the use of squibs of one sort or another. The jack squib, quite commonly employed, is a tinned tube about 1½ inches in diameter and 3 feet long. A smaller tube, containing nitroglycerin and having a detonator on the end of a fuse, is packed in sand in the center of the squib. The end of the fuse—

Various types of anchors used with nitroglycerine shells when shooting oil wells.

Photos, United States Bureau of Mines.
A gusher brought in after shooting a well.



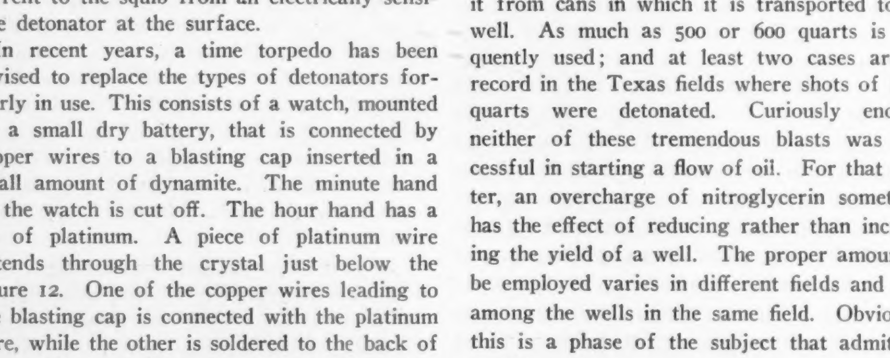
The ticklish business of filling a cartridge with nitroglycerine.

An oil-well shooter, with his nitroglycerine or "soup wagon."

projecting through the side—is lighted, and the squib is dropped down the hole upon the string of shells. The bumper squib, a tube of about the same size as the jack squib, contains an inner tube of nitroglycerin that carries a firing pin and percussion caps. The firing pin is weighted; and, when the dropped squib strikes the torpedoes, the momentum of the firing head is sufficient to explode the caps. The electric squip is lowered into the well by means of insulated copper wires which serve to carry current to the squib from an electrically sensitive detonator at the surface.

In recent years, a time torpedo has been devised to replace the types of detonators formerly in use. This consists of a watch, mounted on a small dry battery, that is connected by copper wires to a blasting cap inserted in a small amount of dynamite. The minute hand of the watch is cut off. The hour hand has a tip of platinum. A piece of platinum wire extends through the crystal just below the figure 12. One of the copper wires leading to the blasting cap is connected with the platinum wire, while the other is soldered to the back of the watch case. When the hour hand reaches 12 o'clock, and the two platinum contacts meet, the electric current is closed and the blast is fired. The entire mechanism is encased in a cast-iron shell which is water-tight. The watch can be started with the hand in any desired position, and the time of detonation thus set for any subsequent hour. This detonator was developed with the idea of reducing the hazards attending oil-well shooting.

On oil-well shooter generally places from 10 to 30 quarts of explosive in each shell, pouring it from cans in which it is transported to the well. As much as 500 or 600 quarts is frequently used; and at least two cases are on record in the Texas fields where shots of 1,000 quarts were detonated. Curiously enough, neither of these tremendous blasts was successful in starting a flow of oil. For that matter, an overcharge of nitroglycerin sometimes has the effect of reducing rather than increasing the yield of a well. The proper amount to be employed varies in different fields and even among the wells in the same field. Obviously, this is a phase of the subject that admits of special study.



Two 10-quart cans of nitroglycerine ready for charging shells.

STORAGE BATTERIES FOR STAND-BY SERVICE

A LITTLE known but important use of storage batteries was dealt with recently in the *Journal of the American Institute of Electrical Engineers.* According to that publication:

"The people of every city make sudden heavy demands upon their electric-light company. The approach of storms and resultant daytime gloom is one of the commonest causes of this. To meet such demands and to guard against power failures many companies maintain immense storage batteries to handle the load during the few minutes that are sometimes required to bring the generating machinery up to speed. These batteries usually are the largest to be found anywhere—some weighing over 3 tons each. A few electric-light plants keep as much as 500 tons of batteries always standing ready for service.

"There are some 18 cities in the United States and Canada in which stand-by batteries are employed in this way. In five representative cities of this class, there are 125 stand-by storage batteries aggregating in capacity 675,000 amperes at the 1-hour discharge rate on the 250-volt bus. These batteries would, therefore, carry the load of 2,700,000 sixty-watt incandescent lamps for one hour, or about twice that many for 20 minutes."

SUPERPOWER DEVELOPMENTS IN GREAT BRITAIN

THE Central Electricity Board, established in Great Britain in 1926 for the purpose of organizing and standardizing the generation and distribution of current in the United Kingdom, has lately issued details of the first part of its extensive program of development. This undertaking, which is known as the Central Scotland Electricity Scheme, 1927, involves an area of some 4,980 square miles, and embraces almost all the industrial, coal, and shipbuilding districts in Scotland.

In that section there are now 36 generating stations supplying electricity. The plan is to reduce the number of these so that there will be but ten interconnected plants, as follows: six are to be retained and to serve as superpower plants and four new superpower stations are to be erected at convenient points. It is estimated that it will take about ten years to complete this initial project.

Other sections of Great Britain—central England, Yorkshire, Lancashire, Cumberland, southeast and southwest England, south Wales, etc.—are similarly to be dealt with in the order of their importance until the entire system throughout the British Isles has been standardized.

The Dominion Government estimates that American automobile tourists spent $203,000,000 in Canada last year, as compared with $188,500,000 in 1925.

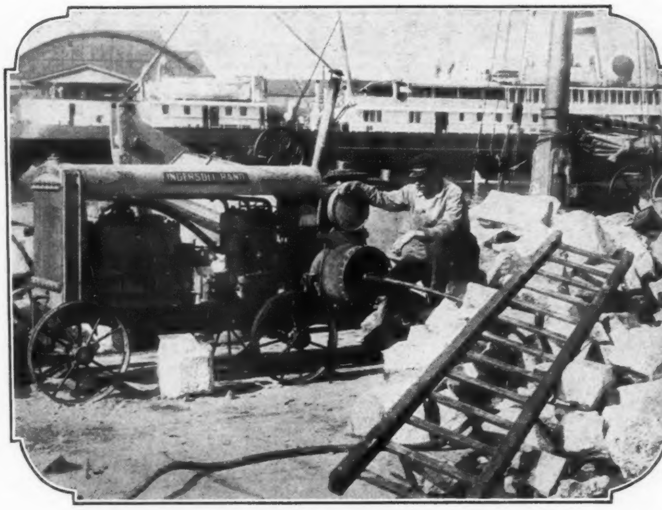
The Chilean Government is trying out a new process for the extraction of copper that makes use of iodine in solution. The process is the invention of Senor Amenabar.

Demolition of Quay Wall In Holland

By G. L. STUYVENBERG

THE City of Flushing, or Vlissingen as Hollanders call it, is a thriving port at the mouth of the West Schelde. Flushing boasts a present population of 23,000; and reasonably aspires to play a still bigger part in the sea trade of Holland than it has heretofore. To this end, the harbor facilities are being systematically expanded to encourage shipping and other contributing industries.

Flushing has figured conspicuously at various times in the history of the Netherlands. It took a leading part during the War of Independence of 1572; and the town was bombarded and captured by the British in 1809. It was held for some time as a hostage by Queen Elizabeth. It was from Flushing that some of the most famous of the Dutch admirals sailed forth to wage war upon the sea; and a statue in Flushing of the great de Ruyter now stands at a vantage point looking toward those waters where once his name spread awe.



Portable compressor that has furnished air to drive the "Jackhamer" used in demolishing a quay wall in the Harbor of Flushing, Holland.

While Flushing is widely known as a delightful seaside resort, colored by much that is picturesque and quaint, still the port has a more material claim to prominence. At Flushing is located one of Holland's largest shipbuilding plants; and there, also, are extensive railway shops, machinery-manufacturing establishments; and numerous other factories. The State Railway terminal at Flushing connects directly with a line of mail, passenger, and express steamers plying between Holland and the port of Queensborough on the coast of England and just north of Dover. Queensborough is a comparatively short run by rail from London. The Queensborough-Flushing route is a popular one; and is much used by tourists and other travelers going from London to northern Europe, or bound from northern Europe to England. Needless to say, Flushing enjoys its present position mainly because of its maritime activities; and a program of expansion is now in hand under government supervision.

The enlargement of the harbor at Flushing has entailed and will further require the demolition of old structures, and among this work has been the removal of a large quay wall built of basalt and concrete. The undertaking was awarded to Messrs. N. V. W. A. van den Tak's Bergingsbedrijf, Rotterdam. This well-known concern is one of the most important of the salvage companies in Holland, and has had some years of experience in submarine work of this character. One of the managers of this company is a Mr. Sperling, a member of a very prominent family of divers.

The quay wall in question was 280 feet long, and had an average thickness of 7½ feet. From the water bed up to the top, the sea wall had a height of 25 feet—9 feet of the structure being above water. The only rapid way that the wall could be demolished was by drilling and blasting. The holes necessary for this purpose were drilled with an Ingersoll-Rand "Jackhamer;" and the air to drive the "Jackhamer" was supplied by a Type 20 gasoline-driven portable compressor. This compressor was placed aboard a barge so that it could be shifted readily from point to point as the demolition progressed.

The holes were drilled in the concrete foundation to an average depth of about 4½ feet. Most of the holes were drilled horizontally; and much of the drilling was done with the "Jackhamer" working submerged. One of our illustrations shows the diver at work with his helmet just above the harbor's surface; but the greater part of the drilling was done completely under water.

When a certain number of holes were drilled, they were loaded with dynamite and the charges fired. After each blast, divers descended in order to supervise the clearing away of the broken basalt and concrete, which was raised by familiar dredging methods; dumped on the decks of barges or scows; and towed away to points of final disposition.

The rapid prosecution of this work is another example not only of the adaptability of compressed air but of the ease with which the portable compressor can be brought into service, either ashore or afloat, to provide motive energy for one purpose or another.

Left—Diver drilling into masonry under water with an air-driven "Jackhamer" during a stage in the demolition of the quay wall. Right—Diver, with "Jackhamer," posing for his picture before donning his helmet for underwater work.

MANY MILES OF TUNNELS IN RAND GOLD MINES

COMPARATIVELY few of the people that are aware of the vast amount of precious metal yielded annually by the famous Rand, of South Africa, realize how much rock must be drilled and blasted and how many miles of tunnels must be driven deep underground in order to bring the gold to the surface for milling operations. The magnitude of the work involved has been summarized in a striking manner by *The South African Mining Review,* from which we quote the following:

"Only those concerned with mining operations on the Rand can have any conception of the toil and money involved in the winning of gold. On the average, each ton of ore contains but an infinitesimal quantity of gold—only about 6⅓ pennyweights. But before the gold can be extracted the ore body must be developed: tunnels have to be driven into it from the shafts so that it can be stoped or mined. These development operations entail nearly 15 miles of subterranean tunneling each month.

"The Government Mining Engineer's statistics for April show that during that month the total development footage was 78,707 feet, equal to 14.9 miles, meaning that tunneling is in progress on the Rand at the rate of 180 miles per annum. In order to carry out this work hundreds of large drills are employed, together with vast quantities of timber, explosives, drill steel, and a multitude of other stores and materials. Development operations are proceeding on the Witwatersrand, over the whole distance from Randfontein on the west to Springs on the east—about 70 miles."

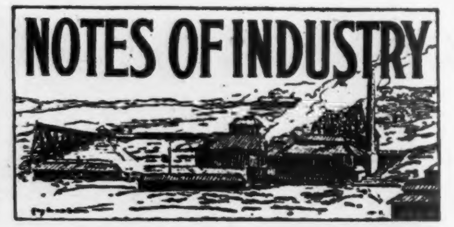
BRICKS FROM WASTE SAND

AFTER half a century and more of persistent effort, it is reported in *The Stone Trades Journal,* a use has been found for the waste sands of St. Helens, England. These sands, of which large quantities are employed there for glass polishing, have been accumulating to such an extent in past years that the town is dotted with numerous unsightly piles of this refuse from the glass plants.

Now, after fortunes have been lost in past attempts to solve the problem, two men of St. Helens, Messrs. Peter Heaton and Horace Pardoe, claim that the sand is suitable for the making of bricks that are in every way equal to ordinary clay bricks. According to the inventors, who have worked on the problem for almost ten years:

"The bricks already produced have been tried by fire and water without revealing crack or flaw. They have been boiled in sulphuric acid for nearly a week, and then for several days in soda. Any brick that can stand tests like that is as good as anything on the market."

The Chief Smoke Inspector of Cincinnati, Ohio, Gordon D. Rowe, has estimated that the annual loss sustained in the United States from smoke and its effects is staggering. Expressed in dollars and cents, it amounts to the appalling total of $1,870,000,000.



From a community of but 12,000 inhabitants in 1901, Tampico, Mexico, the world's foremost crude-petroleum exporting center, has expanded until it now boasts of a population of 80,000.

It is proposed to establish a Chair of Highway Engineering at the London University with funds that are now being raised for the purpose.

Streets in Melbourne, Australia, bounding hospitals and churches may soon be paved with rubber blocks to assure quiet, according to a statement issued by the city engineer.

Following the completion of its work on the January 1, 1927, census, the Automotive Division of the United States Bureau of Commerce has announced that there are now in use throughout the world 27,650,267 motor vehicles. Eighty per cent. of this total, or 22,137,334 automobiles, are registered in the United States.

Canada's newsprint mills started 1927 with a rated daily capacity of 7,350 tons, as compared with 5,700 tons in 1926. If present plans are realized the output will be increased by an additional 1,200 tons per day before the end of this year.

It is reported in the *Chemical Trade Journal* that a Londoner, T. D. Kelly, has discovered a substitute for platinum that can be sold for about $1.20 an ounce. The alloy, of which no technical particulars have been given, has been named solium.

Reclaimed rubber constituted 45 per cent. of all the rubber used in the United States in 1926 in the manufacture of rubber goods. This statement was made in a report issued by the Department of Commerce; and shows the outcome of efforts made in this country to conserve used rubber and to fit it again for service with a minimum of new crude.

According to figures compiled by the United States Geological Survey, the per capita consumption of electricity in this country has increased nearly 70 per cent. in the last eight years. In 1926, every man, woman, and child used 627 kilowatt-hours, as against 371 kilowatt-hours in 1919.

The entrance to the Harbor of Vancouver, British Columbia, is to be bridged at an estimated cost of $3,500,000. The span is to have a length of 1,400 feet, a width of 34 feet, and, at the center, will be 190 feet above high water.

The *Northern Miner* is responsible for the statement that the gold mines in the Belgian Kongo are worked by 18,000 negroes who annually produce gold worth $2,750,000. In northern Ontario, on the other hand, only from 300 to 400 men are required to get out the same quantity of gold within the same interval. It would be interesting to know just to what extent a better class of labor rather than the use of up-to-date machinery contributes to the far greater showing made by the Canadian miners.

Somorrostro Hill, in the Province of Havana, Cuba, was destroyed not long ago at a single blast, yielding 131,000 cubic yards of rock to be used in the construction of the great Cuban Central Highway. The rock was brought down with 15 tons of explosive placed in a 500-foot tunnel especially built for the purpose.

There is reason to believe that the United States produces more than half of the machinery manufactured in the world. But, according to W. H. Rastall, Chief of the Industrial Machinery Division of the United States Department of Commerce, our "participation in the international machinery trade is probably only 25 per cent. of the total—clearly indicating that the manufacturers of this country do not secure their fair share of this business."

The Sudan is the source of 85 per cent. of the world's production of gum arabic of the best quality.

Persons working in malaria-infested countries will be interested in a new drug that is said to be far more effective than quinine in treating cases of malaria. Plasmoquine—as it is named—taken with quinine, will, it is claimed, clear a patient's blood of the most malignant malaria parasite in from five to seven days.

Exclusive of army and navy flying machines, there were more than 1,000 airplanes in the United States at the end of 1926. Of these, 172 were privately owned; 181 were operated by the United States Post Office Department, by mail-carrying companies, and the like; and 650 were in general service.

According to the figures in the last United States Census of Manufacturers, the mechanical power used in American industry increased 30 per cent. from 1919 to 1925 per worker employed, and the value of production per wage earner rose from $2,751 to $3,193 within the same period.

The Egyptian Government is proposing once more to increase the storage capacity of the Assuan Dam—this time, by adding 20 feet to its height, to double its present capacity of 3,270,000,000 cubic yards. This work is to be taken in hand next year; and it is estimated that it will cost approximately $15,000,000.

Compressed Air Magazine

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EDITORIALS

PAN-AMERICAN RAILWAY A STEP NEARER

CENTRAL America for years was isolated from our Southwest because of a lack of a direct rail route tapping the natural riches of that tropical section of the Western Hemisphere. This isolation ceased recently when Mexican enterprise completed an interlinking rail route that should be of advantage to all countries concerned and serve to promote rapid intercourse and still more cordial relations.

The new railroad has called for the exercise of a high order of engineering skill; and it has been carried forward despite many natural obstacles or difficulties of a fairly staggering magnitude. Perhaps we can better grasp what has been done if we quote from an editorial published recently in *The Sun* of New York: "The road was built along the edges of mountain cliffs; in 20 miles of the way there were 32 tunnels and twice as many bridges; in one section there was a series of cañons to be crossed, and in another the engineers solved their problems by several horseshoe curves. The principal bridge, the Salsu Puede, is 740 feet long and 240 feet above the bottom of the cañon. The road traverses a highly picturesque mountain land, a region rich in memories of Spanish exploration in America.

"At Guadalajara, connection is made with the Mexican Railway by which the Guatemalan frontier is reached, and from there the route into Central America is over the Guatemalan Railway. This new line thus opens to American commerce two new fields. It brings the western part of our country nearer to the Central American nations, and it makes easily accessible to the world a rich and almost entirely undeveloped region of western Mexico."

Interesting as this new rail link is because of the countries it will immediately open up to trade and to tourists, the engineering achievement brings one step nearer the fulfillment of still another dream that has long gripped the imaginations of the peoples of Pan-America—we refer to that splendid project, an all-rail route that will some day make it possible to travel uninterruptedly by rail from New York to Rio de Janeiro, and *vice versa.*

When all the Americas are thus brought closer by more rapid means of intercourse than are now available, much sectional or national misunderstanding will disappear, and all the countries involved will be the beneficiaries of a newer and better spirit of interdependence.

BENEFITS OF LABOR-SAVING MACHINERY

MUCH has been said to the effect that labor-saving machinery and tools are designed mainly to turn out a given quantity of work with fewer workers—hence, putting just so many wage earners in the awkward plight of seeking other jobs. This is an erroneous assumption. As a matter of fact, equipment of this sort lightens the task of the worker even though it may enable him to do more work in the course of a day than he otherwise could do. But perhaps the most striking aspect of this use of labor-saving machinery is the quality or the character of the work that can be performed, and this brings in its train results that are a benefit both to the worker, himself, and to the ultimate consumer.

We still have fresh in our minds a visit to a great plant engaged in turning out daily a large number of motor cars of virtually uniform excellence. In that plant compressed air and pneumatic tools of divers kinds are used to bring parts together and to bind them securely so that the assembled vehicle will be strong enough to stand up under repeated and rapidly developed stresses. The wearing quality of the car and the safety of life and limb depend in large measure upon the thoroughness and the faithfulness with which these different operations are performed—operations that would call for sustained muscular effort throughout a working day but for the relief afforded by the use of air-driven tools. In short, the operative can, with these aids, do just as good work at the end of a day as he does when he comes on fresh at the beginning of a shift. We believe that the public and the ultimate consumer should have their attention called to the consequent excellence of the commodity fabricated in this manner.

In a recent issue of the Magazine will be found an article outlining some of the applications of compressed air in a foundry situated in an agricultural section of one of our states. The majority of the workers have been drawn directly from the farm; and, despite the fact that they have had no previous training, they were soon able to qualify for their different tasks and to earn good wages. They were able to do this because air-operated equipment enabled them in a short while to become proficient in a trade that, without these aids, would have necessitated a long period of apprenticeship. The worker is not exploited, as has so often been declared, by the adoption of labor-saving machinery: the gains are reciprocal.

ROCKET-SHIP TO CROSS ATLANTIC

POPULAR imagination was greatly stirred a few years ago when Prof. ROBERT H. GODDARD, a well-known physicist, announced that he was developing a rocket that could propel itself to the moon. Because little has been heard since of this spectacular project, most of us came to believe that the inventor had abandoned that line of work; but a recent news dispatch discloses that he now has in mind a transatlantic rocket-ship that shall be able to make the flight from America to Europe at a very high speed and in a correspondingly brief period of time.

Professor GODDARD is not yet prepared to make public any of the details of such an aerial craft, but it is said that his laboratory work convinces him that he is on the right track. According to an Associated Press dispatch, printed in *The New York Times,* Professor GODDARD declares: "This is no idle dream, but an actual scientific possibility. The idea of combining rocket and airplane is an offshoot of the space rocket on which I have been working for the past eleven years, and whose possibilities I saw clearly as early as 1912. The theory, and that is the main thing, is perfectly sound. The rest will follow with long and laborious experimentation. A flight across the Atlantic for an elaborated rocket, carrying passengers, will be only a short jump in relation to infinity."

There are many of us that would be glad to name members of the first passenger list, although we might be decidedly reluctant about taking the trip ourselves. Professor GODDARD may be perfectly correct in his assumptions; but it will take a number of successful flights to lure the majority of us from the far slower and much safer means of transport.

SAVING EYESIGHT GAINS IMPETUS

IT is heartening to be told how great have been the strides made in the last eighteen years toward eliminating the principal causes of blindness. That this affliction is preventable and that thousands of persons can have unimpaired sight if proper precautions are taken in the early days or the early years of childhood, is the essence of a report lately issued by The National Committee for the Prevention of Blindness.

The report reveals that the percentage of children in the schools for the blind who lost their sight because of "babies' sore eyes"—for centuries the principal cause of blindness—has been reduced more than 51 per cent. in the course of a little more than a decade and a half. The Committee announces the establishment of the country's first pre-school eye clin-

ics for the examination of the eyes of children too young to read, and describes how in these clinics it has become possible to test the sight of children as young as two to six years.

The report discloses that in 1913 there were throughout the United States only two sight-saving classes for the education of children with seriously defective vision and that in 1926 there were 265 such classes. But this is only 5 per cent. of the number of classes essential to provide education for children with serious eye defects without further endangering their sight. In other words, more than 4,700 additional sight-saving classes are needed.

Charts, based on the experience of several of the largest industries of the country, give graphic evidence of what well-organized sight-conservation work has made possible. The companies concerned have thus saved 99 per cent. of the expense previously incurred through eye accidents, and they have, incidentally, saved 92 per cent. of the time formerly lost by reason of such eye accidents.

The Committee states that: "Hundreds if not thousands of eyes and millions of dollars are still lost annually because of the eye hazards of industrial occupations. Any permanent reduction of these hazards calls for the providing and the using of mechanical safety devices; the providing of adequate lighting and sanitary facilities; and the continued education of employers, employees, and governmental officials."

Certainly all thoughtful persons wish that this good work and these efforts towards enlightenment shall go on with added impetus.

HAM AND EGGS OFFICIALLY ENDORSED

JUST how ham and eggs won their way to preëminence on the American breakfast table still remains an unsolved mystery; but scientists in the service of the Government have, after a decade of research, stamped this dietary combination with their approval. This news probably won't materially affect the demand for "hog and hen fruit," but it will satisfy those that believe that the palate, in the long run, knows best what is good for the body.

The thing that does interest, however, is that the serious-minded thinkers of the Government service should spend so much time upon a question that has seldom worried the hungry person—provided he had the price for "ham an'." Somewhere around 1916, dieticians of the United States Department of Agriculture set themselves the task of ascertaining the food value of pork and pork products; and, after 4,000 albino rats had luxuriated upon varying quantities of these commodities, it was proved that pork is more or less rich in one vitamin and correspondingly deficient or low in another essential vitamin. Allied experiments disclosed that the egg is high whereas pork is low in the particular vitamin; and, therefore, the two foodstuffs combined supply the right quantity of vitamins A and B to give us the nutriment for the day's start.

According to a special dispatch in the *New York Sun,* to which we owe this heartening disclosure: "Ham and eggs, bacon and eggs, or sausage and eggs furnish a liberal supply of two important food elements, besides fat, protein, minerals, and other desirable constituents." Please note, however, that nothing is said about wheat cakes or other cakes and syrup—so often added to the bill of fare. Possibly, later, we shall have an official pronouncement concerning these delectable if somewhat debatable comestibles.

THE BRIDGE TO FRANCE, by Edward N. Hurley, Wartime Chairman of the United States Shipping Board. An illustrated volume of 338 pages, published by J. B. Lippincott Company, Philadelphia. Price, $5.00.

LEST we forget one of the really amazing accomplishments of the period of the World War in which we played a conspicuous part, Mr. Hurley has prepared the story of the bridge of ships that we built to neutralize the dreadful ravages of Teuton submarines. The public heard much about the activities of the United States Shipping Board during those very anxious months; and a considerable share of our citizenry had a fair idea of what was achieved by that organization at that time. But it is safe to say that the populace at large has never fully grasped the significance of the amazing work accomplished under the urge of the submarine challenge.

Looking back upon those anxious days, and recalling what was achieved in designing and in bringing into being fabricated and other standardized types of ocean-going craft, it is safe to say that nothing approaching the magnitude of that task was ever before essayed and certainly never before brought to so successful a climax. Mr. Hurley has written with a fund of first-hand information at his disposal. His book is therefore especially authoritative; and it has the added charm of an absorbing and an informative treatment. The volume should be welcomed by all Americans who take pride in the country's solution of difficult problems.

SHALE OIL, by Prof. Ralph H. McKee, and others. An illustrated work of 326 pages published under the auspices of The Chemical Catalog Company, Inc., New York City. Price, $6.00.

PROFESSOR McKee and his associate authors have, in this volume, sought to bring together information that would give the reader a true and correct view of the shale-oil situation and reveal the importance of this oil as a future source of much of the mechanical energy that the nation will surely need. We undoubtedly owe much of our present economic and industrial position in the world to our development and uses of our fuel resources. Petroleum, as we know, has revolutionized American industrial life in numerous ways; and we can continue along the same path of progress only if assured a future commensurate supply either of petroleum or of some other oil that will serve substantially the same purposes. Therefore, the significance of shale oil gathers importance just as our domestic supplies of petroleum diminish in the face of a steadily increasing demand. Professor McKee and his co-workers have produced a worth-while volume.

THE ELECTRIFICATION OF THE NETHERLANDS, an illustrated tome of 568 pages, published by the Central Bureau of the Association of Managers of Electrical Undertakings in the Netherlands, at Masstricht. Price, 25 Gulden.

THIS monumental work was compiled commemorative of the tenth anniversary of the Association of Managers of Electrical Undertakings in the Netherlands. The book, in Dutch, describes the development of the undertakings so represented; and the association is directly connected with the production of substantially 97 per cent. of the electrical energy used in Holland. The work is handsomely and comprehensively gotten up.

THE ROMANCE OF THE ATOM, by Benjamin Harrow. An illustrated volume of 162 pages, published by Boni & Liveright, New York City. Price, $1.50.

IN this book the author has striven—and with success—to describe in nontechnical language, but with due regard to accuracy, the splendid achievements of chemists and physicists in unraveling some of the profound mysteries hidden within the atom. Most of us concern ourselves with big things, because the big and visible appeal directly to our material senses. The scientist, on the other hand, is much more concerned with the infinitely small beginnings of matter and matter's manifestations. The author has done a useful work, because he has made it possible for the popular mind better to grasp what the scientist is doing and, at the same time, to see how the minutely small atom is active in so many ways in things that concern us deeply.

The following new publications of the United States Bureau of Mines may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.:

BULLETIN 271. Problems in the Firing of Refractories, by G. A. Bole, John Blizard, W. E. Rice, E. P. Ogden, and R. A. Sherman. 197 pp. 56 figs. Price. 50 cents.

TECHNICAL PAPER 381. Heavy Liquids for Mineralogical Analyses, by John D. Sullivan. 26 pp. 10 figs. Price, 10 cents.

TECHNICAL PAPER 387. Engine Service Tests of Internal-Combustion-Engine Lubricating Oils Made from California Crude Petroleum, by Martin J. Gavin and Gustav Wade. 57 pp. 9 figs. Price, 15 cents.

Copper in 1925, by C. E. Julihn and H. M. Meyer. 62 pp. Price, 10 cents.

Petroleum in 1925, by G. R. Hopkins and A. B. Coons. 74 pp. Price, 10 cents.

Zinc in 1925, by Amy Stoll. 18 pp. Price, 5 cents.

The K S G Process for Low Temperature Carbonization of Coal is the title of a pamphlet issued by the International Combustion Engineering Corporation, New York City. Copies of this informative publication can be obtained free upon application.